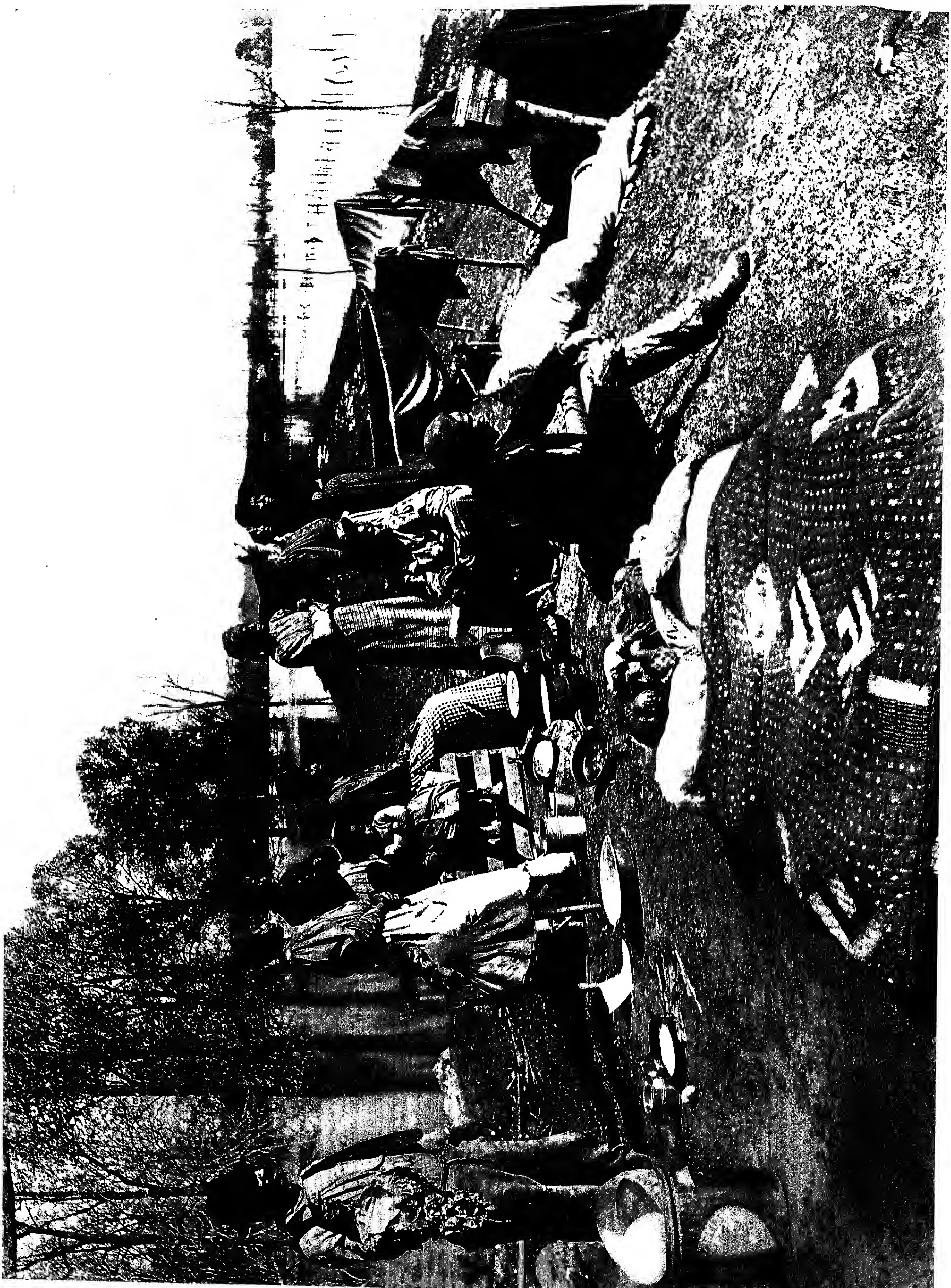
A NATIONAL DUTY

MISSISSIPPI RIVER FLOOD PROBLEM

HOW THE FLOODS CAN BE PREVENTED

By JOHN A. FOX
III

PREPARED AND PRESENTED BY
THE MISSISSIPPI RIVER LEVEE ASSOCIATION
NINETEEN FOURTEEN



"The boat is coming; save what it will take—
I know what you are leaving! Hush, be strong!
We cannot tie our memories up in quilts
For passing Charity to bring!"

THE MISSISSIPPI RIVER LEVEE ASSOCIATION

SCIMITAR BUILDING, MEMPHIS, TENNESSEE

THOUSANDS of business men representing all sections of the alluvial delta affected by the floods of the Lower Mississippi River, have banded themselves together under the name of the Mississippi River Levee Association, an organization maintained entirely by voluntary subscription, for the purpose of gathering data and statistics regarding the delta and its flood problem, in order that the people of the whole nation may be informed as to the extensive area involved and the enormity of the loss sustained by reason of these floods.

The Association has conducted a campaign of widespread publicity and education concerning the country damaged by the floods in order that the general public may understand that the task of preventing them is not a local one but a national one. It has shown clearly and convincingly that the flood waters of thirty-one states, or of more than 41 per cent. of the total area of the Union, deluge this alluvial region almost annually; that these floods can be speedily and economically prevented by a system of levees as recommended by the Corps of Engineers of the United States Army; and that it is obviously the duty of the National Government to aid in preventing these floods.

An office is maintained by the Association in the city of Memphis, Tennessee, mid-way between the head of the delta and the Gulf of Mexico, and the propaganda conducted under its auspices is upon the highest plane and solely in the interest of safeguarding the lives, the homes, and the property of more than a million people from future destructive floods.

Its officers and directors are men of the highest type and many of them are known throughout the nation. Their motives are unselfish and they have given freely of their time and money in order that the nation may be awakened to its full responsibility.

In presenting this publication to the members of Congress the Mississippi River Levee Association hopes that it may be the means of aiding constructive legislation for the good of the whole nation.

THE MISSISSIPPI RIVER LEVEE ASSOCIATION

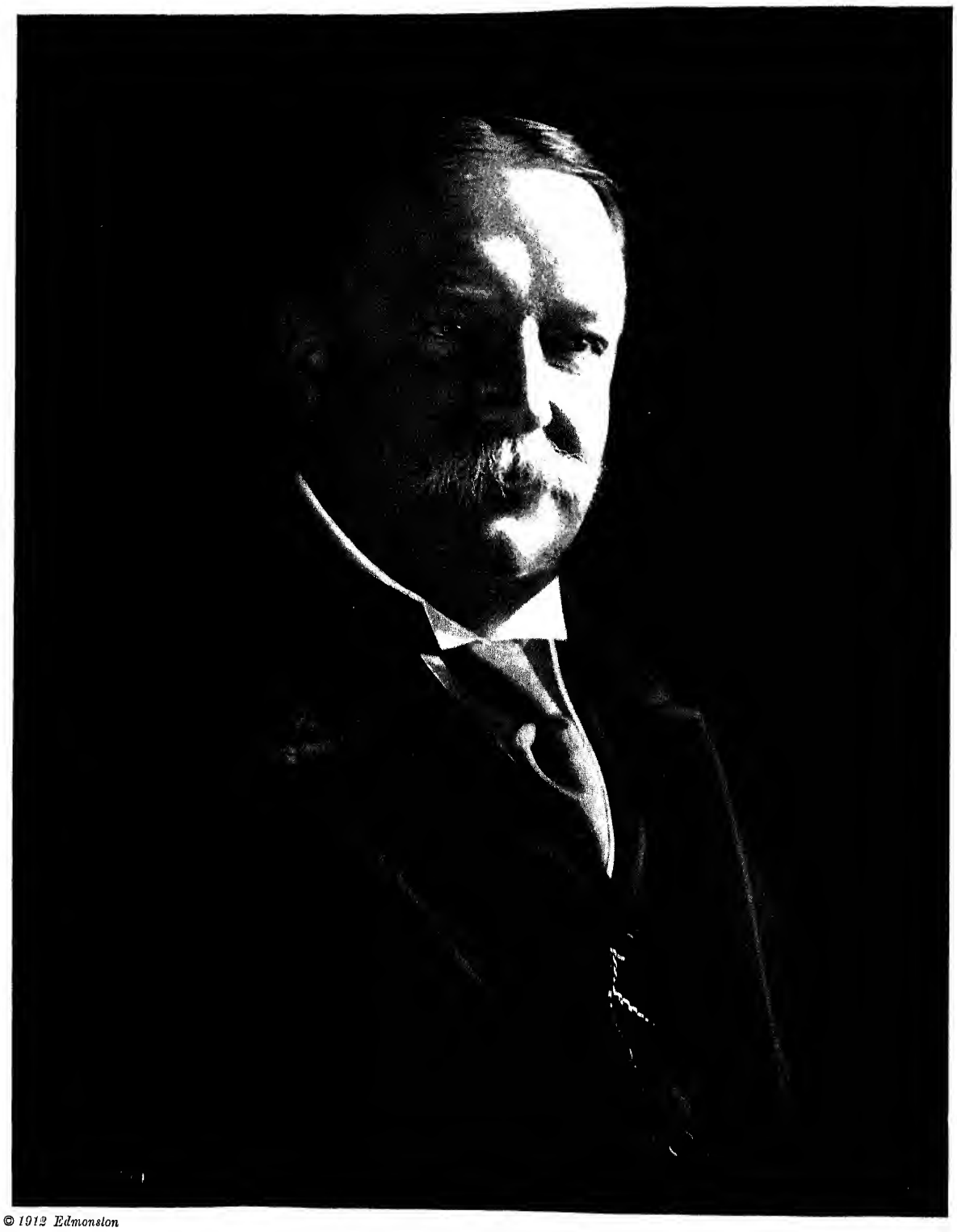
BOARD OF DIRECTORS

J. B. Forgan,	*President First National Bank*	Chicago, Ill.
J. G. Shedd,	*President Marshall Field Co.*	Chicago, Ill.
C. H. Markham,	*President Illinois Central R. R. Co.*	Chicago, Ill.
H. U. Mudge,	*President Rock Island Lines*	Chicago, Ill.
H. F. McCormick,	*Treasurer International Harvester Co.*	Chicago, Ill.
Wm. Wilms,	*Vice-President, Chicago Mill and Lumber Co.*	Chicago, Ill.
G. W. Parsons,	*Mayor*	Cairo, Ill.
F. J. Wade,	*President Mercantile Bank and Trust Co.*	St. Louis, Mo.
W. K. Bixby	*Director St. Louis Union Trust Co.*	St. Louis, Mo.
Rolla Wells,	*Director State National Bank*	St. Louis, Mo.
Murray Carleton,	*President, Carleton-Fergnson Dry Goods Co.*	St. Louis, Mo.
B. L. Winchell,	*President, Union Pacific Railroad Co.*	Chicago, Ill.
F. H. Britton,	*President, St. Louis Southwestern Railway Co.*	St. Louis, Mo.
B. F. Bush,	*President Missouri Pacific Railway Co.*	St. Louis, Mo.
H. L. Block,	*President Union Sand and Material Co.*	St. Louis, Mo.
H. C. Schult,	*Merchant*	Caruthersville, Mo.
S. L. Dodds,	*President Hickman Wagon Co.*	Hickman, Ky.
D. B. Wilson,	*Planter*	Hickman, Ky.
A. S. Caldwell,	*Banker*	Memphis, Tenn.
J. F. Hunter,	*Vice-President U. & P. Bank and Trust Co.*	Memphis, Tenn.
T. O. Vinton,	*President Bank of Commerce and Trust Co.*	Memphis, Tenn.
N. C. Perkins,	*President Central State National Bank*	Memphis, Tenn.
T. K. Riddick,	*Lawyer*	Memphis, Tenn.
W. H. Russe,	*President Russe and Burgess, Inc.*	Memphis, Tenn.
O. C. Armstrong,	*Wm. R. Moore Dry Goods Co.*	Memphis, Tenn.
Paul Dillard,	*President Dillard and Coffin Co.*	Memphis, Tenn.
C. P. J. Mooney,	*Managing Editor Commercial Appeal*	Memphis, Tenn.
Alfred H. Stone,	*Planter*	Dunleith, Miss.
L. K. Salsbury,	*President Mississippi Delta Planting Co.*	Scott, Miss.
W. B. Scott,	*President Sunset Lines*	Houston, Texas
O. N. Killough,	*President St. Francis Levee Board*	Wynne, Ark.
H. D. Tomlinson,	*Planter*	Butler, Ark.
E. M. Ford,	*Planter*	Deckerville, Ark.
M. P. Fulton,	*Manager Indiana-Arkansas Lumber Co.*	Marianna, Ark.
C. R. Smith,	*President Board of Mississippi Levee Commissioners*	Cleveland, Miss.
LeRoy Percy,	*Lawyer*	Greenville, Miss.
J. W. Cutrer,	*President Yazoo-Mississippi Delta Levee Board*	Clarksdale, Miss.
P. M. Harding,	*President Delta Trust and Banking Co.*	Vicksburg, Miss.
W. H. Fitz-Hugh,	*Merchant*	Vicksburg, Miss.
Chas. Scott,	*Lawyer*	Rosedale, Miss.
T. R. Henderson,	*President Bank of Commerce*	Greenwood, Miss.
J. W. Johnson,	*Planter*	Panther Burn, Miss.
Chas. Godchaux,	*President Whitney-Central National Bank*	New Orleans, La.
H. C. Leake,	*President Pontchartrain Levee Board*	New Orleans, La.
Leigh Carroll,	*President Orleans Levee Board*	New Orleans, La.
C. S. Mathews,	*Planter*	Mathews, La.
T. B. Gilbert,	*President Tensas Levee Board*	Wisner, La.
E. G. Swartz,	*Lumber Manufacturer*	Burton, La.
V. M. Lefebvre,	*President Atchafalaya Levee Board*	Port Allen, La.
J. T. McClellan,	*Planter*	Tallulah, La.
Fairfax Harrison,	*President Southern Railway Co.*	Washington, D. C.
R. V. Taylor,	*Vice-President Mobile & Ohio R. R. Co.*	Mobile, Ala.
B. F. Yoakum,		New York City
S. T. Hubbard,	*Ex-President New York Cotton Exchange*	New York City
L. L. Clarke	*President American Exchange National Bank*	New York City
A. L. Shapleigh,	*Chairman Board of Directors Shapleigh Hardware Co.*	St. Louis, Mo.
W. R. Compton,	*President Compton Co.*	St. Louis, Mo.
E. M. Allen,		Helena, Ark.
J. K. Jeffreys,	*Lumber Manufacturer*	Jeffreys, La.
F. M. Rodgers,	*Lawyer*	Arkansas City, Ark.

THE DEMOCRATIC PLATFORM

The Democratic Party at its Baltimore Convention in 1912, declared in general terms for a policy of conservation as to forestation, waterway improvements and water storage, but spoke clearly and specifically regarding this one great problem of the Mississippi River:

> "*We hold that the control of the Mississippi River is a national problem. The preservation of the depth of its water for the purpose of navigation, the building of levees to maintain the integrity of its channel, and the prevention of the overflow of the land, and its consequent devastation, resulting in the interruption of interstate commerce, the disorganization of the mail service and the enormous loss of life and property, impose an obligation which alone can be discharged by the general government.*"

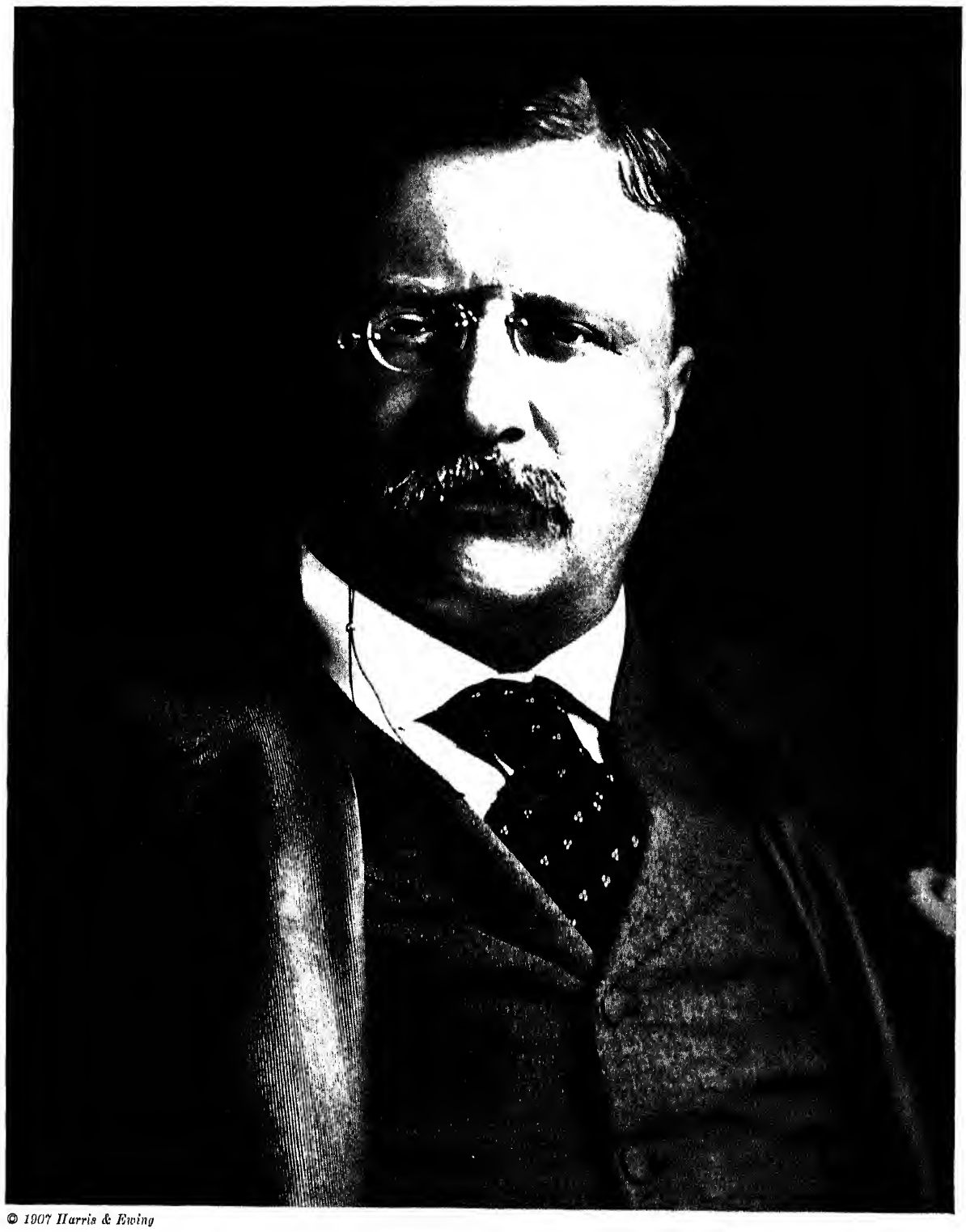


"I favor the expending of the whole fifty million dollars that will be required to put into levees to save that part of the country from floods, and putting it into law."

THE REPUBLICAN PLATFORM

The Republican Party was equally as pronounced in its attitude towards this great project and at its convention in Chicago in 1912 declared explicitly as follows:

> *"The Mississippi River is the Nation's drainage ditch. Its flood waters, gathered from 31 states and the Dominion of Canada, constitute an overpowering force which breaks the levees and pours its torrents over many million acres of the richest land in the Union, stopping mails, impeding commerce, and causing great loss of life and property. These floods are national in scope and the disasters they produce seriously affect the general welfare. The States unaided cannot cope with this giant problem. Hence we believe the Federal Government should assume a fair proportion of the burden of its control so as to prevent the disasters from recurring floods."*



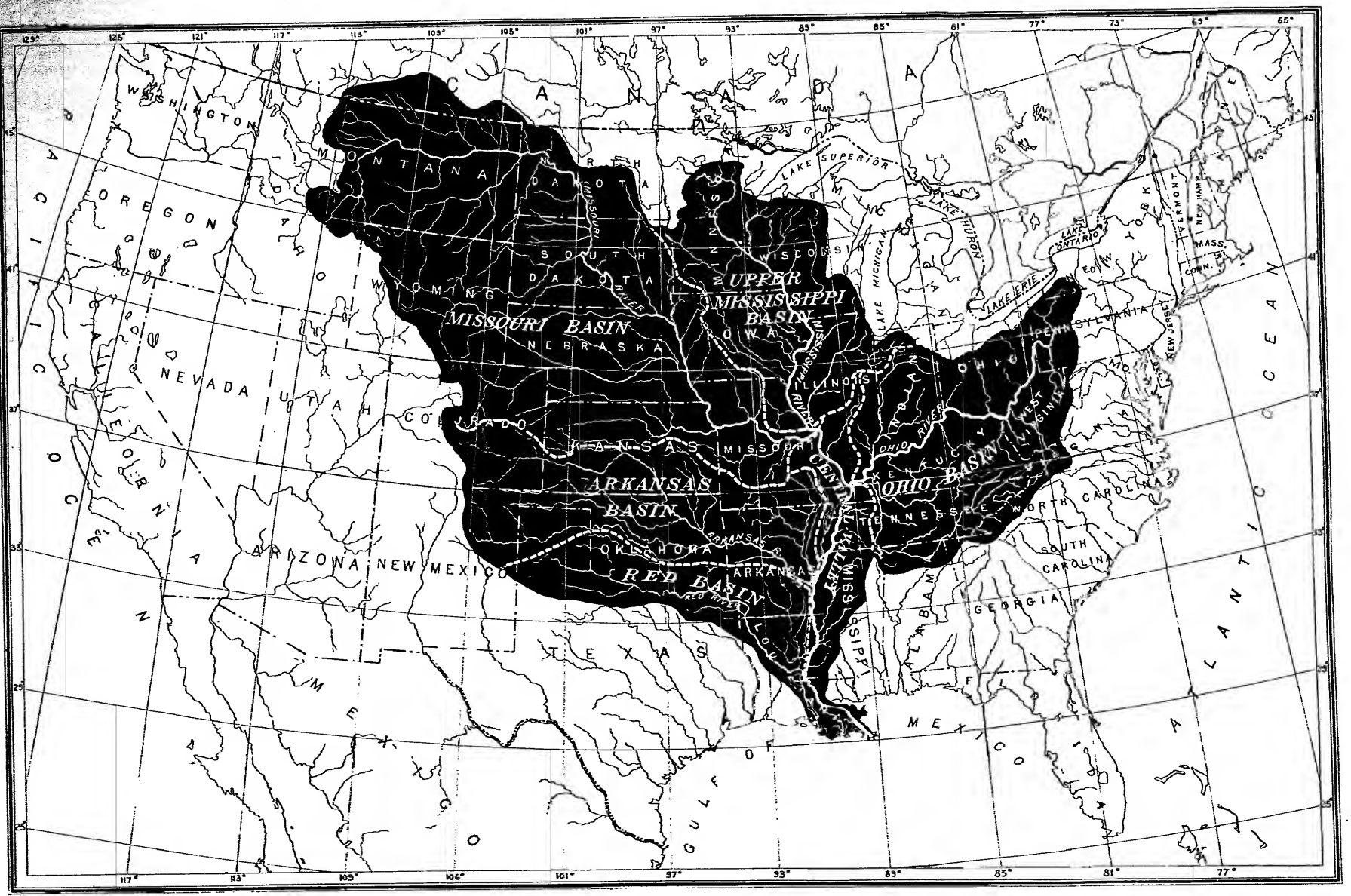
"We, the Nation, must build the levees and build them better and more scientifically than ever before."

Theodore Roosevelt

THE PROGRESSIVE PLATFORM

The Progressive Party at its Chicago Convention made general conservation one of its principal themes and yet that Party selected this one great project and said "especially the Mississippi River."

> *"It is a national obligation to develop our rivers, and especially the Mississippi and its tributaries, without delay, under a comprehensive general plan covering each river system from its source to its mouth, designed to secure its highest usefulness for navigation, irrigation, domestic supply, water power and the prevention of floods. We pledge our party to the immediate preparation of such a plan, which should be made and carried out in close and friendly cooperation between the Nation, the States and the cities affected. Under such a plan the destructive floods of the Mississippi and other streams, which represent a vast and needless loss to the Nation, would be controlled by forest conservation and water storage at the headwaters and by levees below, land sufficient to support millions of people will be reclaimed from the deserts and the swamps, water power enough to transform the industrial standings of whole States would be developed, adequate water terminals would be provided, transportation by river would revive and the railroads would be compelled to cooperate as freely with the boat lines as with each other."*



THE DRAINAGE BASIN OF THE MISSISSIPPI RIVER

AREA 1,240,050 SQUARE MILES

All of the flood waters that come from the shaded area pass through the Lower Mississippi River and damage the adjacent States

THIS IS CLEARLY A NATIONAL PROBLEM

THE Flood Problem on the Lower Mississippi River stands out distinct and unique among similar problems elsewhere throughout Christendom.

First: Because of the extensive area damaged. The floods that affect the Lower Mississippi River cover an area as great as the combined areas of Vermont, New Hampshire, New Jersey and Connecticut—29,000 square miles. When the levees gave way in 1912 more than 12,000 square miles of this valley were inundated, an area as great as the area of Switzerland.

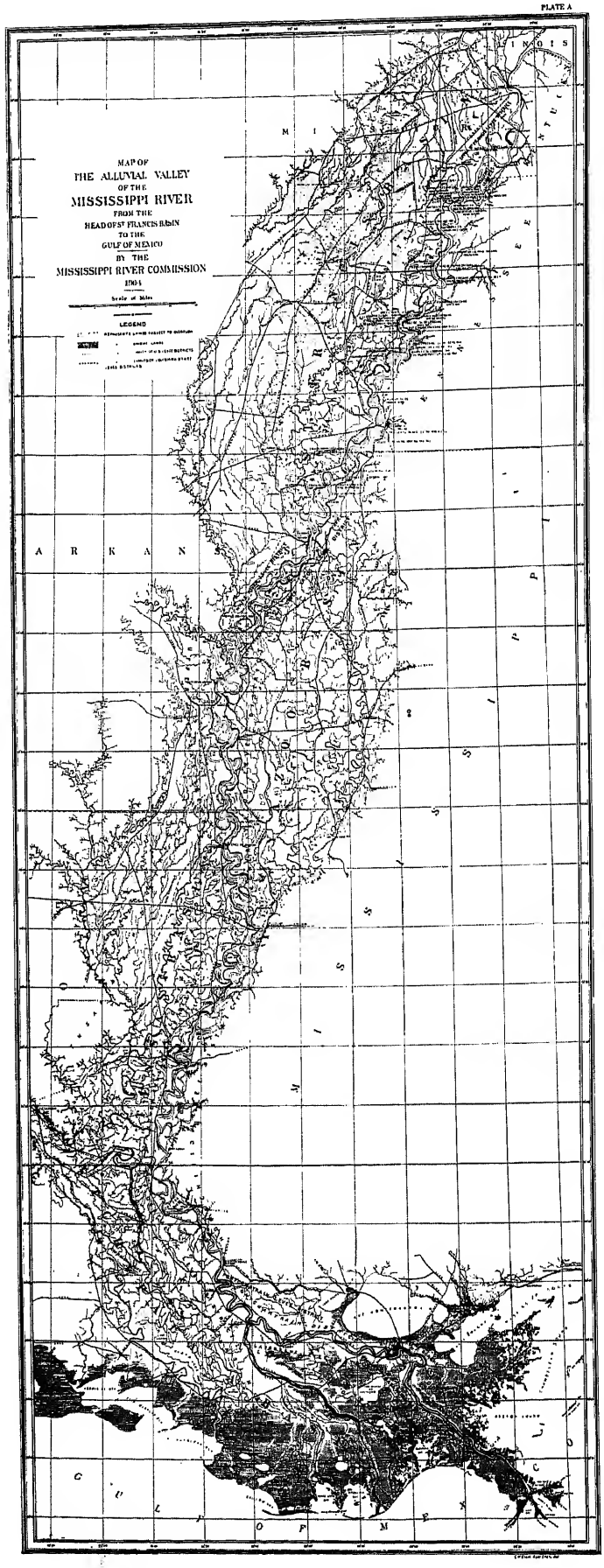
Second: Because the damage incurred is caused by the waters from a territory entirely outside of the states whose land is involved. "The process by which the country above is relieved is the process by which the country below is ruined." Of the water that damages the Lower Mississippi Valley region less than one per cent. comes from the states damaged by these floods.

Third: Because of the magnitude of the problem it can justly and rightly lay claim to be a national enterprise, there being thirty-one states, or nearly half the territory of the United States, involved. By referring to the map on the opposite page it will be seen that the waters which damage this valley come from New York as well as from Montana, from Minnesota as well as from Alabama.

Fourth: Because of the duration of the floods that affect this part of the country. When the flood waters break through the levees in this region they remain upon the land from the first of April until the middle of June.

Fifth: Because the magnitude of the undertaking is such that the Nation alone can cope with it, and because so great a part of the Nation is injured that the whole Nation is affected.

Sixth: The Mississippi River flood problem has been studied by eminent engineers and investigated by Congress for a period of more than half a century, all surveys, plans and estimates have been made, and the engineers are prepared to begin work without further delay.



MAP SHOWING THE ALLUVIAL DELTA OF THE MISSISSIPPI RIVER DAMAGED BY FLOODS

COMPARATIVE AREAS

	Square miles
Alluvial Delta of Mississippi River	29,790
State of Indiana	36,350
State of South Carolina	30,570
State of Maryland	12,210
State of Massachusetts	8,315
State of New Jersey	7,815
State of Rhode Island	1,250
Combined areas of four States	29,590
Area of Scotland	30,443
Area of Denmark	15,388
Area of Switzerland	15,976
Combined areas of Switzerland and Denmark	31,364

COST COMPARISONS

Reclaiming 2,000 square miles in Zeider Zee by Holland Government	$46,000,000
Reclaiming 2,200 square miles in Egypt by British Government	53,000,000
Protecting 29,790 square miles in the Mississippi Delta	60,000,000

The area of the Delta is four times as large as the State of New Jersey; six times as large as the State of Connecticut; fifteen times as large as the State of Delaware; twice as large as Holland.

This area can be entirely protected from floods by a system of levees such as has been planned by the Mississippi River Commission at an estimated cost of $60,000,000.

DESCRIPTION OF THE ALLUVIAL DELTA AND THE LEVEE SYSTEM

BEGINNING at the foot-hills of the Ozark Mountains, near Cape Girardeau, Missouri, and extending south to the Gulf of Mexico is a great level plane five hundred and fifty miles long and some fifty miles in width, through which the main body of the Mississippi River flows after being joined by the waters of the Ohio. This plane is similar in extent and fertility to the Babylonian Plane of the Euphrates and the Egyptian Plane of the Nile, and is known as the alluvial delta of the Mississippi.

The river meanders through this rich valley with a total length of 1060 miles, a total fall of 269 feet during low water, and of 321 feet during high water. As the course of the river traverses the valley, it divides it into geographical basins or sub-divisions such as the St. Francis Basin on the west side in Missouri and Arkansas; the Yazoo Basin lying wholly in Mississippi; the White, the Tensas, the Atchafalaya and Lafourche Basins lying on the west side in Arkansas and Louisiana; and the Ponchartrain and Lake Borgne Basins on the east side in Louisiana.

Like all silt-bearing streams the Lower Mississippi River has done much towards building its own levees, as the lands of the basins on either side of the river are much higher near the banks than at the edges farthest away. All of the drainage from these basins, is, therefore, away from the main body of the river and into tributary streams which lie parallel and empty into it several hundred miles below, such as the St. Francis, the Yazoo and the Tensas.

Under normal conditions the flood waters which gather from north, east and west and empty into this part of the river at Cairo, follow the main channel and are conducted to sea, just as a main sewer receives and carries off the storm water of a city. But *under the abnormal condition which has arisen from the rapid development and drainage of the areas in the states above*, the water now rises much higher than its natural banks and the necessity has arisen for artificially raising the banks or building levees to confine the water to its main channel.

On the west bank these levees begin opposite the city of Cairo and extend to the mouth of the St. Francis River near Helena, Arkansas; then a gap to admit the St. Francis and they extend to the mouth of the White River. Another gap to admit the White and the Arkansas rivers and the line begins below the mouth of the Arkansas and continues to the mouth of Red River. Another gap and the line begins again below the mouth of that river and continues unbroken to Fort Jackson near the mouth of the Mississippi.

On the east bank the high hills of Kentucky and Tennessee border the river down as far as Memphis. There is an area of 575 square miles in these two states with 26 miles of levee already constructed.

Just below Memphis the levee begins again and follows the bank of the river until the mouth of the Yazoo is reached. From below the mouth of that river the hills of Mississippi and Louisiana constitute a barrier down as far as Baton Rouge, Louisiana, and there the levee line begins again and extends unbroken to Ft. St. Phillip near the mouth of the Mississippi on the east bank.

The total length of these two parallel lines of levee is 1538 miles and the land protected from overflow by them amounts to about 20,000,000 acres in the six states affected. Fully 16,000,000 acres of this area are capable of being reclaimed and placed in a high state of cultivation if protection from floods can be obtained.

THE MISSISSIPPI RIVER COMMISSION

CONGRESS long ago recognized the necessity for a commission of distinguished experts to study the Mississippi River problem and provide a remedy, and by Act of June 28, 1879, created what is known as the Mississippi River Commission and prescribed its duties:

"Be it enacted by the Senate and House of Representatives of the United States of America assembled, that a commission is hereby created, to be called 'The Mississippi River Commission,' to consist of seven members.

"Sec. 2. That the President of the United States shall, by and with the consent of the Senate, appoint seven commissioners, three of whom shall be selected from the engineer corps of the Army, one from the Coast and Geodetic Survey, and three from civil life, two of whom shall be civil engineers.

"Sec. 3. It shall be the duty of said Commission to direct and complete such surveys of said river * * * and to make such additional surveys, examinations and investigations * * * of said river and its tributaries, as may be deemed necessary by said commission to carry out the objects of this Act.

"Sec. 4. It shall be the duty of said Commission to take into consideration and mature such plan or plans and estimates as will correct, permanently locate and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof: *prevent destructive floods;* promote and facilitate commerce, trade and the postal service * * * ."

In accordance with this Act the following distinguished men were appointed members of the Commission by President Hayes and held their first session August 21, 1879.

Gen. Q. A. Gillmore, Corps of Engineers, U. S. Army, President.
Gen. Benjamin Harrison, afterwards President of the United States.
Maj. B. M. Harrod, subsequently member of the Panama Canal Commission.
Capt. James B. Eads, of St. Louis, distinguished throughout the world as an engineer.
Gen. C. B. Comstock, Corps of Engineers, U. S. Army.
Maj. C. R. Sutter, Corps of Engineers, U. S. Army.
Prof. Henry Mitchell, of the Coast and Geodetic Survey.

As vacancies have occurred on the Commission since that time they have been filled by men of equally high character and efficiency and the work begun in 1879 has progressed as rapidly as the meager funds provided would permit.

The first work of the Commission was an elaborate and detailed survey of the entire alluvial region from Cairo to the Gulf of Mexico. Every foot of the 1066 miles of the river was surveyed and platted and every particle of information that could be secured was obtained, and the plans for preventing disastrous floods and for improving the channel of the river have been based upon the data thus obtained. The expenditure of such moneys as have been allotted to the Commission by Congress for carrying its plans into effect has been under the direction of the Corps of Engineers of the United States Army.

The present personnel of the Commission is as follows:
Col. C. McD. Townsend, Corps of Engineers of U. S. Army, President.
Hon. Robert S. Taylor, Fort Wayne, Indiana.
J. A. Ockerson, Civil Engineer, St. Louis, Missouri.
Homer P. Ritter, Asst. U. S. Coast and Geodetic Survey, Washington, D. C.
Chas. H. West. Civil Engineer, Greenville, Mississippi.
Col. Lansing H. Beach, Corps of Engineers, U. S. Army, Baltimore, Maryland.
Maj. Clarke S. Smith, Corps of Engineers, U. S. Army, St. Louis, Missouri, Secretary.

This body of men is as able a body of experts as can be found to deal with the Mississippi River Problem and they are prepared with all the necessary plans, data and estimates to proceed at once if Congress will authorize the work to be done.

THE FREQUENCY OF DISASTROUS FLOODS

THERE is a flood in the Lower Mississippi River every spring which rises above the level of the land in the alluvial delta, but every few years there is a great flood, and the frequency with which these abnormal floods come is illustrated by the data given below.

Flood of 1718—"An extraordinary rise of the Mississippi this year."—FRANCOIS XAVIER MARTIN.

Flood of 1735—Gayarre states that "in this year the waters were so high that many levees were broken and much damage was done."

Flood of 1770—"A great flood," according to the tradition recorded by Governor Sargent.

Flood of 1782—"This year the Mississippi rose to a greater height than was remembered by the oldest inhabitants."—FRANCOIS XAVIER MARTIN.

Flood of 1785—"A great flood at St. Louis in April, said to have been equal to that of 1844."

Flood of 1791—"Same remarks at New Orleans as for flood of 1785."

Flood of 1796—"The Teche overflowed its banks for some 60 miles above New Iberia and poured into Grand Lake in a smooth sheet of water."

Flood of 1799—"Same remarks at New Orleans as for flood of 1785."

Flood of 1809—"A disastrous flood, which, according to Governor Sargent's notes, inundated all the plantations near Natchez and destroyed the crops. It was imagined by the sufferers that the northern lakes had found a channel to the river."

Flood of 1811—"There was a great flood this year."—BRECKENRIDGE.

Flood of 1813—"Was 6 to 8 inches higher than 1811."—BRECKENRIDGE.

Flood of 1815—"A very great flood. At the mouth of the Ohio it attained the highest point ever recorded, two feet above the high water of 1858."

Flood of 1816—"Same remarks at New Orleans as for flood of 1785."

Flood of 1823—"This was a great flood, which was highest at Napoleon on June 1st and at Natchez on May 23rd. A great number of crevasses occurred below Red River on both banks of the river."

Flood of 1824—"This flood was 0.7 of a foot below the high water of 1815, or 1.2 feet below that of 1859, at Natchez, according to the notes of Mr. Samuel Davis."

Flood of 1828—"This flood occurred before the country above Red River landing was much settled and is almost universally claimed to have been the greatest flood of the present century."

Flood of 1844—"At St. Louis it exceeded the preceding rise by more than 8 feet and all other floods of which we have records by more than 4 feet."

Flood of 1849—"Its highest stand occurred about the middle of February, when it was 3.3 feet below the high water of 1858. In the latter part of March it again reached nearly the same level."

Flood of 1850—"This flood was caused by heavy rains, which produced freshets successively in the Arkansas, Red and Black rivers, and thus flooded the whole region below Napoleon. The water did not subside until the middle of June. The damage occasioned by the flood was immense. The St. Francis and Yazoo bottoms were not protected by levees, and both were deeply flooded."

Flood of 1851—"Excepting the floods of 1844 and of 1858, this was the greatest flood at St. Louis of which we have records. The flood of 1858 was 0.4 of a foot above that of 1851. At Cape Girardeau the flood of 1851 exceeded the flood of 1858."

Flood of 1858—"For seven days it amounted to 1,475,000 cubic feet per second. It inundated the city of Cairo. It washed away miles of the insignificant levees along the St. Francis front, and poured rapidly into the bottom lands of that river, which were already deeply overflowed from heavy rains and from the crevasses of the April rise."

Flood of 1859—"The highest point attained at Memphis in 1859 was 0.1 of a foot below the high water of 1858. At Vicksburg it was 1.3 feet above the high water of 1858."

The above records were taken from the report of Humphreys and Abbot, published in 1861, and the following record of great floods, as measured by the gauge at Cairo, is from the report of the Chief of the Weather Bureau, the record of the floods of 1858 and 1859 being repeated for the purpose of comparison.

Year	Cairo Guage	Year	Cairo Guage	Year	Cairo Guage
1858	49.5	1881	45.8	1897	51.7
1859	46.5	1882	51.8	1898	49.8
1862	50.7	1883	52.3	1903	50.6
1867	50.9	1884	51.8	1907	50.3
1874	47.4	1886	51.0	1912	53.0
1876	46.4	1893	49.3	1913	54.7

VARIOUS METHODS PROPOSED

VARIOUS methods for protecting the Lower Mississippi Delta from inundation have been suggested, and each one of them has been fully discussed during the past hundred years. A brief review of the various plans proposed will be given here with the conclusions arrived at in each case under the heads: Reforestation, Reservoirs, Cut-Offs, Outlets, and Levees.

REFORESTATION

THERE has been much discussion both in Europe and in this country regarding the relationship between cutting off the forests and excessive floods, and reforestation has been advanced as a possible method of reducing the flood plane of the Lower Mississippi River. A very able presentation of this subject was made before the American Society of Civil Engineers by H. M. Chittenden, Member of that Society, November 4, 1908, from which I quote the following:

"It follows that no aid is to be expected in the control or utilization of our rivers, either for flood prevention, navigation or water power, by any practicable application of forestry. Remember always that it is the extreme of flow, not the medium condition, that controls the cost of river regulation. It is the floods and low waters that measure the cost. Any scheme of control that is not based upon these is worthless. This proposition need scarcely be urged upon the experienced engineer. For himself he would never place any real reliance upon forestry. * * * In like manner no engineer could honestly advise lowering in height by a single inch the levees of the Mississippi because of any possible application of forestry to the water-shed of that stream. And again he could not advise that forestry development would lessen in any degree the cost of improving the rivers for low-water navigation. * * * Hence the complete divorcement of forestry from any connection with river regulation—so far, at least, as its effects upon the cost of such regulation is concerned—will be a distinct and positive gain to the latter."

Mr. Chittenden's analysis of the whole subject is very clear and very convincing, and I recommend it to the careful consideration of those who are advocating forestry reservation as a means of flood prevention.

In an address by Col. C. McD. Townsend, President of the Mississippi River Commission, delivered at Memphis in September, 1912, he covers the subject fully and concludes as follows:

"In other words, to reduce the height of a flood at Memphis by reforestation at the headwaters of the river from that of 1912 to the next highest on record, would require a forest reservation of about 566,000 square miles, an area exceeding that of the portions of Montana and Wyoming drained by the Missouri River and the States of North and South Dakota, the portion of Minnesota drained by the upper Mississippi River, and the States of Iowa, Wisconsin, Illinois and Indiana. But even such a forest reservation would afford only partial protection, and large expenditures for levees would still be required. Under the above assumptions, to prevent any overflow by reforestation would necessitate a practical abandonment of the valley for agricultural purposes and the development of an extensive irrigation system to produce tree growth in arid regions of the West.

"It is therefore apparent that even under the most extravagant claims of forestry advocates reforestation as a means of reducing flood heights on the Mississippi River requires the conversion of too much farming land into wilderness to be practicable. The waste land that can profitably be converted into forest reservations is too limited in area to produce an appreciable effect on the floods."

RESERVOIRS

THIS plan is to hold back, in the flood season, by systems of artificial lakes upon the tributaries of the Mississippi, such a volume of water as may be requisite to reduce within banks the floods of the river. The volume thus held back is to be retained for improving low-water navigation. The discharge of each tributary is thus to be more nearly equalized throughout the year, and a double advantage secured.

Commenting upon such a method of reducing the flood plane in the lower Mississippi River, Humphreys and Abbot in their report remark as follows:

"The floods of great rivers are torrents, caused by rapidly melting snows and by widely extended and heavy rains. The greater part of this water does not drain from the remote mountain sides, and issue from the distant mountain gorges. It falls in the valley itself; and the nearer to the main river, the more sudden and disastrous will be its effects; partly from the more rapid accumulation in the main stream of the contributions of the tributaries, and partly from the absence of the natural reservoir furnished by the various channels, which must be filled before a freshet originating near the sources can reach the lower part of a river. To control such floods with certainty and economy by artificial reservoirs, it is, therefore, essential that certain important tributaries which drain relatively large portions of the basin shall debouch near their mouths from narrower gorges, where dams can be constructed at reasonable cost, and where artificial lakes can be formed without injury to other interests.

"But these essential conditions are the very reverse of those existing upon the lower Mississippi. It is empahatically a river which drains a plain. The area of the narrow border of mountains around it is insignificant, when compared with the great extent of its basin. Moreover, the downfall of rain upon these mountains is but little more than half of that which falls upon the same area near the great artery itself; for, as already seen, it derives by far the greater part of its annual and of its flood discharge from the central and nearly flat portion of its valley. If we add to these peculiarities the fact that its main tributaries are all navigable rivers, which are too valuable, as routes of communication, to be interfered with by dams, even if the system were otherwise practicable, it is evident that reservoirs can be located only in the narrow belt of mountains upon the borders of the basin, where, as already seen, they can have but little effect upon the floods."

After proving conclusively that it would be a physical impossibility to remedy the floods on the lower Mississippi River by a system of reservoirs, these able engineers declare: "*It would be a work of supererogation to discuss questions of cost, now that the physical impossibility of protecting the alluvial region from overflow by this system has been made so evident.*"

Mr. H. M. Chittenden, Member of the American Society of Civil Engineers, in his very exhaustive treatment of this subject before that body, November 4, 1908, says:

"*The more closely this reservoir proposition is scrutinized, as a scheme for flood prevention, the more impracticable it appears.* It is only a trade-off at best. It is giving up to perpetual overflow valuable lands to save others from occasional and even rare overflow for short periods. Now if, at less cost, these lowlands can be better protected by other means, thus leaving both the valley lands and reservoir sites open to productive use, how much better it will be!"

Colonel Townsend says:

"To have retained the Mississippi flood of 1912 within its banks would have required a reservoir in the vicinity of Cairo, Illinois, having an area of 7,000 square miles, slightly less than that of the State of New Jersey, and a depth of about 15 feet, assuming that it would be empty when the river attained a bank-full stage.

FROM the report of Humphreys and Abbot made in 1861, I quote the following: "The system of diminishing the natural resistances opposed to the flow of the water, by cutting off the bends of a river and thus lowering the surface, has often been advocated for restraining the floods of the Mississippi River, and has even been partially applied under the authority of the General Government and of state legislation. It should therefore be fully discussed."

"It is an essential part of the system of cut-offs, as proposed by writers on hydraulics, that the cuts shall be made continuously from the mouth of the river to that portion where it is proposed to reduce the height of the floods. This is urged upon the ground that the greater velocity of the water in the part where the slope has been increased by a cut, will bring a larger volume in floods to the portion below the cut, where the slope has not been increased, and where, consequently, the water will rise higher than before. A second cut must therefore be made below the first, and so on to the mouth. This reasoning may be sound when applied to the small streams had in view by the writers, where a few hours make a material change in the flood, but evidently it is not applicable to the Mississippi, where the water often remains for weeks at flood height. Moreover, such extended operations are manifestly impracticable, and, therefore, need not be considered."

The practical effect of cutting off a single bend of the Mississippi is then determined with much certainty from the measurements made at Red River cut-off made in 1831; Raccourci cut-off made in 1848; False River in 1722; American Bend cut-off in 1858; and by specific instances on the River Po in Europe, and the following conclusion drawn:

"It has been shown by the preceding discussion that a cut-off raises the surface of the river at the foot of the cut nearly as much as it depresses it at the head. The country above the cut is therefore relieved from the floods only at the expense of the country below. Moreover, if a series of cut-offs were to be made extending to the mouth of the river, the principles educed show that the heights of the floods would be regularly decreased from a point near midway of the series to the upper end, and regularly increased from the same point to the lower end. *The system, therefore, is entirely inapplicable to the Mississippi River, in whole or in part.*"

In addition to the foregoing argument against cut-offs as a means of flood prevention, I quote the following from Col. C. McD. Townsend, President of the Mississippi River Commission:

"The Mississippi River Commission in numerous reports has called attention to the injury which would result from cut-offs, the increased caving which is caused thereby, and the damage to navigation during low water. I desire to invite attention to the fact that cut-offs have been repeatedly tried in Europe as a means of reducing floods, but always with disastrous results. The most noted example is the River Theiss in Hungary.

"This river originally had a very gentle slope, about equal to that of the Illinois River below LaSalle. It was leveed with the same results which always obtain when rivers are confined—the heights of its flood increased. It was then proposed to shorten the river by cutting off the bends and thus giving it a deeper slope. The project was carried out, but the first great flood that occurred after the work was completed rushed through the improved section much faster than the lower part of the river could carry it off. Flood heights were lowered, to be sure, at the upper end, but correspondingly increased at the lower, and in 1879 the town of Szegedin was destroyed by the flood."

OUTLETS

MANY have advanced the theory that floods in the Lower Mississippi River might be prevented by the construction of outlets, or waste-weirs, by which surplus water would be conducted to the Gulf by channels other than that of the main river. Such a plan was investigated by Maj. J. G. Bernard, Corps of Engineers, U. S. Army, as early as 1822 and commented upon as follows:

"Paradoxical as it may appear, then, it is a certain result of the foregoing principles, that the more water we throw off by waste-weirs, after we have passed that limit at which the velocity is just sufficient to keep the bed clear, the higher will the surface ultimately become."

Humphreys and Abbot investigated this proposed remedy in their thorough study of the river, between 1850 and 1861, and found that two great difficulties were encountered. The first was that outlets would cause the bed of the river to silt up, upon which they commented as follows:

"The consequent reduction of volume in the main river would lessen the depths upon the bars at its mouths, besides impairing the navigability. Constant examination would therefore be required to ascertain whether such changes were taking place, which, if detected, could be arrested only by closing the outlet. * * *

"If actual measurements establish that crevasses—which, so far as they affect the river, are outlets under another name—do produce deposits in the channel below them, the injurious effects of the system are proved. That measurements do establish this fact has been repeatedly asserted, and appears to be generally believed."

The second was that these outlets, providing short-cuts, would become the main channel of the river and thereby prove very disastrous, upon which they comment thus:

"These views are not speculative. There are well-authenticated instances of the Po and the Rhine, under circumstances somewhat similar to those attending the existence of the supposed outlet, having opened new channels to the sea, which are now either the main stream or principal branches of the rivers. * * *

"With reference to the extent and cost of the works, it is apparent that a channel must be prepared for the outlet entirely through the swamp to the lake, so as to give a free discharge to its waters; for, if they were merely conducted to the swamp, the thick growth would so impede their flow that enormous levees would be required for many miles above and below the outlet, in order to protect the rear of the plantations from overflow."

The report concludes "*Enough has been said to demonstrate, with all the certainty of which the subject is capable, the disastrous consequences that must follow the resort to this means of protection.*"

The Mississippi River Commission has given this subject a great deal of study and in the first report of the Commission, dated February 17, 1880, in which a plan of improvement was recommended, we find this reference to the outlet system:

"The Outlet system, by which a portion of the flood waters of the river would be drawn off and conveyed through shorter routes to the Gulf, being one of diffusion and waste, and having very little in the way of either theory, experience or observation to recommend it, was unanimously rejected by the Commission for reasons set forth in the report."

Commenting upon the outlet system in a recent address, President Townsend of the Mississippi River Commission said:

"Another serious objection to an outlet is the difficulty in regulating the velocity with which the water will flow through it at varying heights of the main stream. If it is so constructed that it will discharge at a greater velocity than the river itself, there is danger of its enlargement to such an extent as to divert the greater part of the flow down it, and transfer the main stream itself into an outlet; and if, on the other hand, it discharges at a lower velocity, it will tend to fill with sediment."

LEVEES ARE THE ONLY SOLUTION

THE first official action taken by the General Government regarding floods and their prevention on the lower river was made in 1822 when Bernard and Totten of the Corps of Topographical Engineers were sent to investigate. Their report was made on December 22, 1822, and declares "The only means which appear practicable to us is the construction of dykes." The next official report by Humphreys and Abbot, in 1861, embraces perhaps the most exhaustive study that has ever been made of the subject. In its final analysis of plans for protection the report says:

"The preceding discussion of the different plans of protection has been so elaborate and the conclusions adopted have been so well established, that little remains to be said under the head of recommendations. *It has been demonstrated that no advantage can be derived either from diverting tributaries or constructing reservoirs, and that the plans of cut-offs, and of new or enlarged outlets to the gulf, are too costly and too dangerous to be attempted. The plan of levees, to the contrary, which has always recommended itself by its simplicity and its direct repayment of investments, may be relied upon for protecting all the alluvial bottom lands liable to inundation below Cape Girardeau.*"

The following excerpts from the reports of the Mississippi River Commission as far back as 1880 are conclusive regarding the levee system as the only means of protection.

In the report of 1881 we find the following:

"The utility of levees as a means to 'prevent destructive floods,' which is one of the ends enumerated in the Act creating the Commission, is too obvious to require comment."

In the report of 1884, the president of the Commission, Lieut.-Col. C. B. Comstock, reports to the Secretary of War, Robert T. Lincoln, as follows:

"The Act creating the Commission makes it the duty of the Commission to consider the subject of the prevention of destructive floods, and, as bearing upon that matter, there is submitted for information the following summary of the probable extent and cost of such a system of levees as would be necessary for that purpose. *It is obvious that for the secure protection of the Valley from overflow there is necessary a system of levees high and strong enough to withstand the greatest flood. No other means of protection is practicable or even possible.*"

In 1885 Colonel Comstock reiterates:

"A majority of the Commission states: 'We therefore conclude the levees, such as have been described herein, are, in connection with an equalization of width and the prevention of caving, an important part of any general and systematic plan for the improvement of the navigation and prevention of destructive floods.' I fully concur with the majority as to the necessity of such levees to restrain destructive floods, and believe it to be the only method by which the great value of the bottom lands of the Mississippi can be fully developed."

In 1898 the Senate Committe on Commerce, after investigating the entire subject, reported as follows:

"From all the evidence taken by the Committee it is evident that the basins along the Mississippi River can only be protected from floods by an ample and complete system of levees from Cairo to the head of the Passes."

In a letter to the Chief of Engineers, May 6, 1913, Col. C. McD. Townsend, President of the Mississippi River Commission, writes as follows:

"Levees afford the only practicable means of preventing the damages which might be caused by floods in the Lower Mississippi Valley. They have been successfully employed on European rivers, and are the only means of flood protection of large rivers that have been tested, or, if tested, have not failed. To restrain floods like those of 1912 and 1913, will require in the existing levee line about twice the yardage now in place."

THE BED OF THE RIVER IS NOT RISING

An authoritative statement by the Mississippi River Commission

THE Commission has long since established the fact that there has been no progressive elevation of the bed of the river, but it may be well to repeat here in part what has appeared from time to time in our annual reports. In the Commission's report of 1890 will be found a memorandum on the question as to whether building levees along a river causes its bed to rise and the following extracts give the gist of this discussion:

The Po. "The River Po has long been leveed and it is often stated that its bed has risen largely in consequence of levees. * * * The gauge readings which have only been kept since 1807, show that there has been no important rise of the bed of the river at Ponte Lagoscuro in the sixty-eight years covered, and, in connection with Zendrini's observations, show that there has been no probable rise of any importance since 1720, although the raising of levees has been going on during this period."

The Rhine. "The Rhine is also a river which, below Dusseldorf, has long been leveed, and if levees raise the bed of a river here they should have produced their full effect, as they are rarely broken. * * * Hagen carefully examined the gauge readings at Cologne from 1846 to 1879 and at Dusseldorf from 1800 to 1879 to detect changes in high and low water heights. * * * At Dusseldorf he found that with great probability there was an annual sinking of the maximum high water in each year amounting to 0.3 inches; that the mean stage did not change, and that the annual lowest waters showed with some probability an annual increase of one-twelfth of an inch.

For Cologne he found that with great probability the high waters had sunk and the lowest waters had risen by about the same amounts as at Dusseldorf. A rise of one-twelfth of an inch in a year, or eight inches in a hundred years, is so small as not to be an important matter in a system of levees, and if the hundred years of table above are taken the rise disappears."

The Yellow River. "It has often been asserted that the bed of the Hwang-Ho, or Yellow River, of China, has risen above the surrounding country, where it is leveed. The error, originally due to Abbé Huc, has been repeated by English writers on China. The following extract from a letter to me by Gen. J. H. Wilson (a very competent authority) gives reliable information on the subject:

" 'In conclusion, I do not hesitate to say that I cannot but believe that Abbé Huc was entirely mistaken in regard to the silting up of the channel, and that an exhaustive survey would prove beyond a doubt that no such silting as to raise any part of the bed above the adjacent territory has ever taken place.' * * *

"From the examination of the Po and Rhine it may be concluded that if their beds rise in the leveed portions (which is not entirely certain from the data), it is at so slow a rate as not to be an important factor in the maintenance of a levee system. * * * On the Mississippi, the records, while not extending over a period long enough to give final results, do not, so far as they go, indicate that the bed has risen. * * *

"In the general survey of the river made by the commission in 1880-1883 all soundings and elevations between the high-water banks of the river were referred to an established datum plane, and this gave a large number of definite elevations with which later surveys could be compared."

"The results of the comparisons of so large a number of elevations justify the conclusion heretofore stated, that *there has been no measurable progressive elevation of the bed of the river during the period covered by the investigations cited.*"

BRIEF HISTORY OF THE LEVEE SYSTEM

THE first levee system on the Mississippi River of which we have any record was begun in 1717, when De la Tour, the engineer who laid out the city of New Orleans, directed that "a dyke, or levee, be raised in front, the more effectually to preserve the city from overflow." This was not completed until 1827.

In 1752 the settlement along the river extended for 50 miles, "was in a high state of cultivation and securely protected from floods."

In 1802 there were but few settlements along the river; New Orleans, Baton Rouge, Point Coupee, and Concordia, Louisiana; Napoleon, Arkansas, and New Madrid, Missouri. "In 1828 the levees were continuous from New Orleans to Red River Landing, except on the left bank, where the bluffs rendered them unnecessary. Above Red River they were in a very disconnected and unfinished state on the right bank as far as the mouth of the Arkansas."

Such levees as existed in 1850 had been built by the plantation owners themselves aided by the county and parish governments. They were small and of insufficient section and gave way before the larger floods.

In 1850 a great impetus was given to the work of reclaiming the alluvial region below the mouth of the Ohio by the Federal Government, which, by an act approved September 28, 1850, granted to the several states all swamp and overflowed lands within their limits remaining unsold, in order to provide a fund to reclaim the districts liable to inundation.

When Humphreys and Abbot made their investigation in 1857, they found that considerable levee work had been done and that levees from three to four feet in height existed along the St. Francis Basin and along the Yazoo fronts, and while they reported that there were a number of openings or gaps in this levee line, yet it showed that the nucleus of a system had been begun. They concluded, however, with the statement that these levees were much too low and too narrow, as the flood of 1858 proved.

In 1858 and 1859 occurred the greatest floods that had been known on the lower river and such levees as had been built up to that time were to a great extent destroyed. The Civil War then came on and the stricken country was able to do but little in restoring its levees and completing them to grade.

In 1879 the State of Louisiana created a Board of State Engineers and began in a systematic and effective manner to repair and reconstruct its levee system. Beginning in 1886 special acts were passed by the legislatures of that and succeeding years enabling taxing districts to be formed. Under these several acts all of the alluvial portion of the State is now organized for levee protection.

The alluvial portion of the State of Mississippi was enabled by law to form such taxing districts about 1880 and active work towards perfecting a levee system has since continued under two such districts, and while the levee line is continuous along the front of this region 98.5 miles of the line at the upper end are maintained by one district and the remaining 186.5 miles at the lower end by the other.

The St. Francis Basin in Arkansas and Missouri was the last section of the alluvial delta to be organized for flood protection. In 1893 acts were passed by the legislatures of these two states creating special taxing districts and the work of reconstructing the levees swept away by the flood of 1859 was begun. A continuous line of levees two hundred and twelve miles in length, which reaches from Point Pleasant, Missouri, to the mouth of the St. Francis River in Arkansas, is now more than sixty per cent. completed, and the work of bringing the entire system up to the full grade and section is being carried forward as rapidly as finances will permit.

LEVEE BUILDING

THE LEVEES ARE NOT COMPLETED

THE levees that have been built to restrain floods along the Lower Mississippi River have increased in height and section as money for their construction became available and at the present time contain approximately 243,000,000 cubic yards of earth. Their height varies as the ground upon which they are located is high or low compared to the high-water plane, although at present the average height is about 15 feet. The top or crown is from 8 to 10 feet wide and the base is usually six times as great as the hieght, the slope on either side being 3 feet horizontal to 1 foot vertical.

They are constructed entirely of earth, the material for their construction being taken from the riverside or inside. The lines upon which they are located follow the general direction of the river bank, a wide margin which varies from 1000 to 5000 feet being left between the levee and the bank of the river.

In the earlier days of levee building the earth was moved by wheelbarrow, later wheel scraper and teams were used and now much is done by traction engines and graders. The cost of the work has become greater as the height of the levees has increased and averages now about 25 cents per cubic yard.

About 230,000,000 cubic yards will be required to complete the existing system and if the entire work can be undertaken as a whole, much of the cost can be saved by the utilization of modern methods and machinery.

It is estimated by the Mississippi River Commission that the entire system of levees along the Mississippi River can be completed during the next five years at a cost not to exceed $60,000,000.

CLEARING LAND

WE ASK FOR PROTECTION NOT RECLAMATION

WE ARE not asking the National Government to reclaim our lands. This statement is made emphatically because many of those who are unacquainted with the situation seem to be under that impression. We are simply asking protection from the floods of other states that bring destruction to the lands which we have already reclaimed.

The building of the levees is like guaranteeing to the land immunity from foreign invasion; or like the establishment of a national quarantine. The work of reclamation can begin only after protection has been assured.

Of the 16,000,000 acres in the entire delta which can be reclaimed and utilized, only about 3,500,000 acres have thus far been reclaimed and developed.

Such protection as these lands now have in the way of levees has been secured at a cost of about $70,000,000 to the owners, or about $4.00 per acre. The stupendous task of reclamation by drainage and clearing begins after that, and costs from $50 to $70 per acre.

The above illustration shows how the clearing is done. This land in its virgin state cost the owner $22 per acre with only the present partial guarantee from floods; the clearing will cost him about $35 per acre and to this he must add from $6 to $10 for a system of drainage canals.

The clearing and reclamation of land has progressed most rapidly during recent years in the St. Francis Basin in Arkansas and in the Yazoo Basin in Mississippi, and as illustrative of the transformation from forest land to field land it may be stated that the assessed valuation in the St. Francis Basin alone has increased from $4,000,000 in 1893, when the levees were begun, to $44,000,000 at the present time.

RECLAMATION

RECLAMATION FOLLOWS PROTECTION

RECLAMATION in the delta will follow protection just as civilization followed military occupation in developing the virgin West. After being assured that the flood waters of the Mississippi will be kept off of the land, steps must be taken to remove the storm and surface water; and extensive systems of drainage canals must be planned and carried out in each of the great alluvial basins.

This work has progressed rapidly in all sections of the delta as the levees have neared completion, and during the last ten years many thousands of acres have been drained and reclaimed. This work has been particularly noticeable in the St. Francis Basin in Missouri and Arkansas.

The picture shown above illustrates the method of cutting the main arteries. Over 1000 miles of such canals have been constructed in the alluvial delta since 1901. The breaking of the levee which protects this region from Mississippi River floods will cause these improvements to be greatly damaged if not entirely destroyed.

As soon as assurance shall have been given that positive protection from overflow may be expected, many thousand additional miles of these drainage canals will be undertaken. A great system has already been planned for the St. Francis Basin in Missouri, which will cost about $5,000,000; another one in the St. Francis portion of Arkansas will cost about $6,000,000; and still another one in the upper portion of the Yazoo district that will cost equally as much. Thus it will be seen that the people of this section are ready and willing to bear their part of the burden. They are not asking for reclamation—they are asking for protection.

HOME OF COTTON

WORLD'S FINEST COTTON PLANTATIONS

THE assurance of adequate levee protection to the alluvial delta will bring into cultivation the greatest cotton producing area in the world. Peculiar conditions of soil, climate and humidity render the bottom lands of the Mississippi delta especially fitted for the growth and production of cotton, and it is on these lands that the finest grades and the longest staple is now grown.

It is conservatively estimated that twelve and one half million additional acres of this cotton-producing land will be put in cultivation during the next few years if adequate protection from overflow can be secured. The land is exceedingly fertile and with but ordinary care and cultivation will produce a bale of cotton to the acre.

The total production of cotton in the United States last year amounted to 15,000,000 bales. If this additional cotton acreage is opened up to cultivation through levee protection the output of cotton in the United States can easily be increased to 25,000,000 bales. This will mean an annual increase of $750,000,000 to the wealth of the nation at the most conservative estimate.

In view of the fact that foreign nations are now making every effort to compete with this country in the matter of cotton production, it seems highly important that serious consideration should be given to the levee question by Congress if for no other reason than to maintain that supremacy which we now enjoy in the cotton production of the world.

The flood of 1912 inundated over 12,000 square miles of the delta land and much of the three and one-half million acres already developed stood under water for sixty days. It is to protect the lands already developed that we are asking the nation's cooperation.

LAND OF CORN

ACRES OF CORN FIELDS EVERYWHERE

IN FORMER years nearly all of the corn needed by the large cotton and sugar plantations in the Mississippi delta was brought down the river from Illinois and from the Missouri River states by barges and flat boats, very little corn being raised on these lands. Now, however, most of the corn needed is produced in the delta country.

In the delta lands of Arkansas and Missouri corn is usually the first crop that is planted after the land has been drained and cleared, this crop being followed later by crops of cotton or alfalfa which yield greater returns, but which cannot be grown successfully until the lands are entirely free from stumps.

The illustration given above shows the extensive scale upon which corn is grown and cultivated in the Yazoo bottoms of Mississippi. In 1910 the total corn production of the State of Mississippi amounted to 28,428,667 bushels, and of this amount 5,448,527 bushels were contributed by the fifteen delta counties, although only a small portion of the land is as yet reclaimed.

Louisiana has made great strides in the last few years as a corn producing state, and although hardly more than 30,000,000 bushels were produced in 1912, it is expected that this amount will be doubled during the coming year.

There are nearly 14,000 square miles of alluvial delta land located in the state, and these lands are proving as valuable as the lands of Illinois for growing corn. Many thousand acres of the marsh lands of Louisiana are now being reclaimed, and if protection from floods can be definitely secured, it will be but a short time before the present corn production of Louisiana will be trebled.

ALFALFA FIELDS

GREAT PASTURES OF GROWING ALFALFA

ALFALFA has become one of the staple crops of the delta region during recent years and is being grown with remarkable success in the reclaimed portions of the St. Francis Basin. Many thousand acres of this crop are to be found today in the alluvial valley of the Mississippi which equal, if they do not exceed, the famous alfalfa lands of Colorado and California.

As those familiar with this crop know, it can be harvested year after year without replanting, the new plants coming up in the spring from well-embeded roots which sometimes penetrate 30 feet into the earth. The crop is a valuable one and yields from five to eight tons per acre, but it is a crop that is easily destroyed by standing water, and when the inadequate levees break, enormous damage is done by the destruction of the alfalfa fields in the already developed portions of the delta.

It is safe to predict that if a guarantee can be secured against these destructive floods there will be more alfalfa produced by the alluvial delta than by any other section of the United States, the irrigated regions of the West not excepted.

The illustration shown above depicts one of these beautiful alfalfa fields in southeast Missouri, and because of the great value of this crop as a stock feed, it is believed by many that stock raising will become one of the most important industries of the delta region in the near future. While its cultivation is being carried on much more extensively in southeast Missouri at the present time than it is elsewhere, still its cultivation is extending rapidly into all portions of the delta below.

SUGAR INDUSTRY

EXTENSIVE SUGAR PLANTATIONS EXIST

SUGAR CANE is grown more extensively in the alluvial bottoms of Louisiana than anywhere else in the United States. All of that portion of the delta below the mouth of Red River is peculiarly adapted to its growth because of the richness of the soil, the semi-tropical warmth of the region and its great humidity.

Great sugar plantations with their expensive plants for making and refining sugar have existed in that section of the delta since its first settlement and development.

Sugar cane is an expensive crop to produce and harvest, and must be raised on a large scale to be profitable, so that many houses for the hands, many barns for the mules and many miles of railroad must be provided and maintained. Each of these large plantations is like a little city in itself and they border in continuous succession the Mississippi River, Bayou Lafourche, Bayou Teche and other streams that traverse the delta.

Frost and flood are the most destructive elements to this crop. It springs up each season from the stubble of the year previous, much as the banana tree does in the tropics, and the cost of replanting is thus obviated, the stand being renewed about every three years. This is the reason that the floods of the Mississippi River cause such great losses in the sugar belt when the levees break. Not only is the growing crop destroyed but the stubble is killed and the entire area must be replanted the following year.

In addition to this loss is the enormous loss caused by water standing for weeks around the expensive machinery of the great refineries and the damage done by the floating off of the hundreds of miles of tram road needed to bring the cane to mill.

RICE CULTURE

RICHEST FIELDS OF RICE ABOUND

RICE is one of the staple crops of Arkansas and Louisiana and is produced in large quantities in the delta region of the latter state. Many thousand acres of this crop are grown on the lower reaches of Bayou Lafourche and the Mississippi River, water being pumped over the levees during the low water period for irrigating the fields.

Until within recent years most of the rice produced in Louisiana was raised on these delta lands, but it is now grown more successfully on the prairies in the southwestern part of the state, where there is little danger from floods.

There are several million acres of marsh land throughout the gulf portion of the delta, however, that will undoubtedly be reclaimed and utilized as rice land when the levee system shall have been completed. The work of reclamation has already begun and large sums are being expended by private owners in digging canals and installing pumping plants, but all of this will be rendered futile unless some definite assurance can be had that the levees along the Mississippi will hold within bounds the floods that come down the river from the North.

The total production of rice in the United States in 1911 amounted to 22,934,000 bushels and of this amount 11,693,000 bushels was produced by the State of Louisiana. So it will be seen that this delta state now produces more than half the rice raised in the United States, and would undoubtedly produce more if protection were afforded by a good system of levees.

ORANGE GROWING

VARIED INDUSTRIES ARE PROTECTED

ORANGE culture has come to be synonymous with Florida and southern California, but the delta lands of southern Louisiana produce the finest quality of citrus fruit that can be obtained. In the early history of this section of Louisiana when floods were less frequent and less destructive, splendid orange groves were to be found on both banks of the river below New Orleans, but as the trees are easily damaged by standing water many valuable orchards have been killed by the recent floods.

OYSTER INDUSTRY

Another valuable industry that is badly crippled when the levees break is the oyster industry. Some of the finest oyster bedding grounds of this country are located along the bays and inlets of the delta coast where the fresh water discharged through the mouth of the river does not reach them, but when the levees break and these beds are covered with fresh water floods, millions of oysters are destroyed, so every barrel of oysters now pays its tax to the levee fund.

THE NATION'S VEGETABLE GARDEN

The delta portion of Louisiana nearest the Gulf Coast is the vegetable garden of the northern cities, and it is here that tons of fresh vegetables are raised during January and February to supply the markets of Chicago, Boston and New York. These vegetable gardens of the nation are destroyed when the levees break and the land remains under water for weeks at a time.

LUMBER INDUSTRY

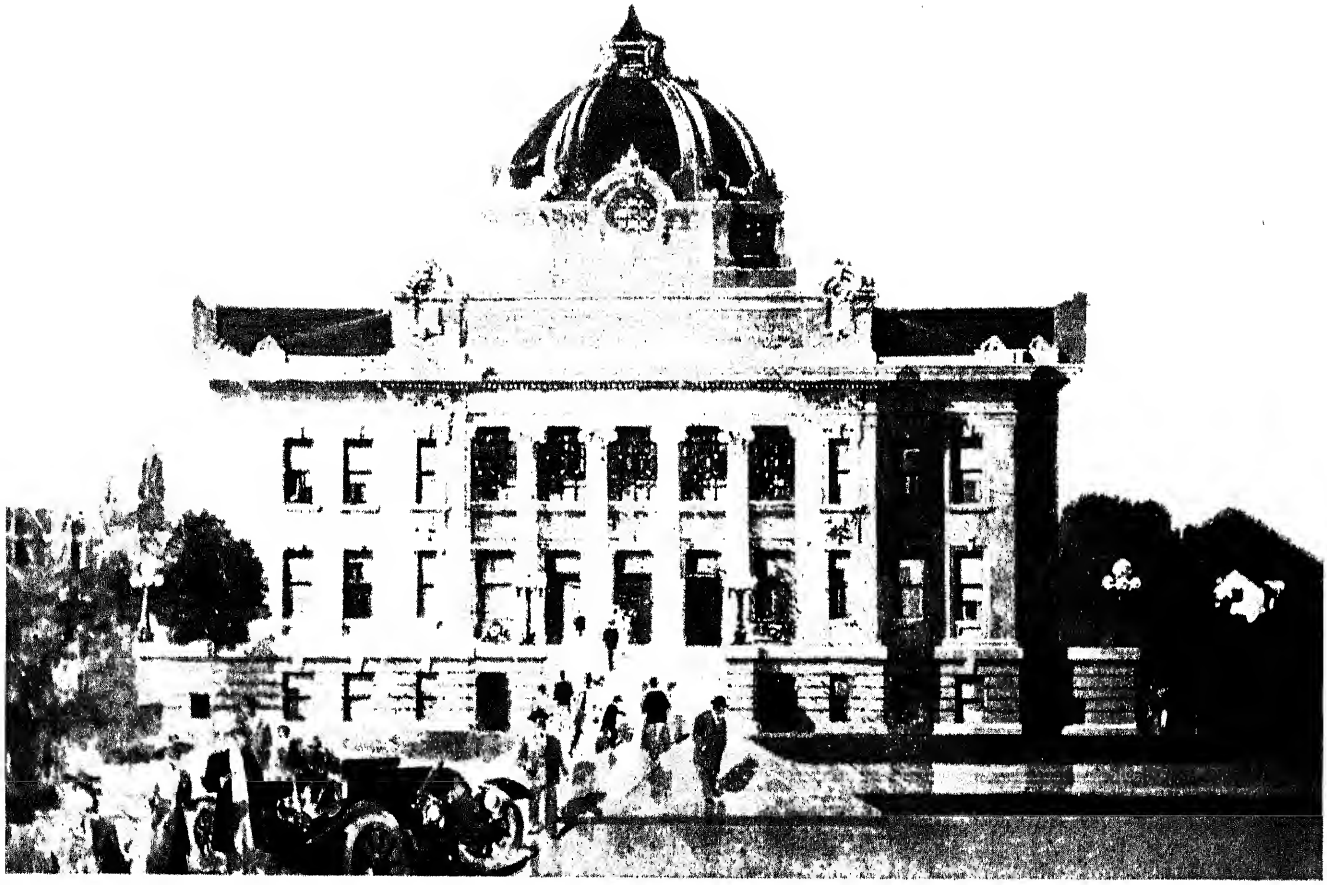
THE DELTA YIELDS VALUABLE TIMBER

AS THE levee system has increased in efficiency during the last twenty years and as immunity from floods has seemed more and more certain, the vast wooded area of the delta region has come to yield its quota of the world's supply of lumber. Prior to the building of the levees permanent improvements could not be made in the delta to any great extent, but during the last two decades many lines of railway have been extended into this region in Missouri, Arkansas, Mississippi and Louisiana, and have opened up millions of acres of hardwood forests.

Extensive saw-mills are now located in every section of this rich region and many millions of dollars are invested in plants of this character throughout the entire delta country from Cape Girardeau to New Orleans. Many of these mills have built their own lines of railroad, so that in addition to the mileage of standard gauge railroads now traversing the delta there are hundreds of miles of these lumber roads.

There are millions of feet of lumber cut and stacked on the yards of the various mills when the levees break and the loss to this industry in the delta region is enormous. Water sometimes stands five or six feet deep for weeks at a time, rusting the machinery, floating off the tran-roads and so staining the valuable hardwood lumber already cut as to render it unfit for market.

So rapidly has the hardwood lumber industry grown in the delta region during the last few years that more than 600,000,000 feet, valued at $15,000,000 are taken out annually, through the city of Memphis alone.



GROWING CITIES

PROSPEROUS CITIES NEED PROTECTION

CITIES have sprung up in all parts of the delta as the work of reclamation has progressed and it is to protect these cities and their inhabitants from destruction and ruin that the co-operation of the National Government is now asked.

There is a mistaken idea prevalent in the minds of many people throughout the United States which leads them to believe that the people of this section are asking Congress to reclaim their lands. These people have already spent $70,000,000 in levee building alone, although the real work of reclamation does not begin until after the levees are built.

As late as 1880 there was but a small portion of the delta lands of Missouri, Arkansas and Mississippi in cultivation, and but few cities of any size existed. To-day, after twenty years of levee building to protect these delta lands, there are scattered throughout this region hundreds of thriving cities, towns and villages of from 1,000 to 10,000 inhabitants.

As a futher evidence of the development of the alluvial delta since the levee system has been brought nearer to completion it may be stated that although in 1880 there was but one banking institution with a capital stock of $20,000, situated in the delta, in 1910 there two hundred and forty-six banking institutions with a combined capital stock of $16,000,000.

The illustration above shows the type of public buildings that are now to be found at many of the county seats throughout the delta. The floods of nearly half the nation pour down the River and threaten these growing and prosperous cities every spring, and unless some assurance is given by the National Government that these floods will be controlled their ruin is inevitable.

THE BREAKING OF THE LEVEE

VIRGINIA FRAZER BOYLE

You ask if it will hold? It must! it must!
Come, men! and build it strong enough to stand
The awful strain, the pressure from above
That drives the river from its rightful bed.
If that were all! Do you remember that
Which came upon us last year in the spring?
Go, leave your plows, bring every negro hand—
There is no other help save in ourselves!
Close up your schools and let the children come
And stand in line, for we must save the land.
Your fields and mine to-day—ah! God how long
Shall they be ours?—with all their verdant spoil
Of mellow acres greening row on row,
With promise of a plenteous year of ease;
The happy flocks that spot the green with white;
The sleek young mules that in your pasture graze;
The fattening pigs and cows that multiply,
And swell the worth of goods that we thought ours.
If it should break, what then? It must *not* break;—
There are no loiterers here—our women's hands
Are filling up the gunny sacks with earth
So that we spare none from the levee's top.
Your hands are horny, hard with toil, and mine—
Come, let us make them hornier yet, and wrench
Our all in safety from the river's maw;
Your wife, your children wait—a little hand
Is throwing kisses to you from the porch.
Beside your children stands your faithful dog;
Ah, God! this thing we build that we call home!
And yonder, silent, 'neath the stone you raised,
There sleeps the father, who first cleared the land.
The water lay upon them just last year,
Shall they be lost again within the flood—
The home, the land, the grave, the harvest, all?
Heap up the sacks, pile on the earth, nor let
The daybreak find one sleeping, nor the night
A single hand at rest!
Oh! how the river howls and boils and rolls,
So hungry to be at us, at our hearts—
Now let us keep it back, you blacks have all,

And we have much to lose;
Come, keep it back,
And let a year of plenty follow us;
Stop every crawfish hole, fill in that crack
As zealously as you would guard your life.
There's rest in August under fruiting trees,
And fullness too, when we have saved the land!
What is it there? A sand boil down below;
Quick! rally forces, double at the spot!
One foot of earth drops in, pile on the sacks,
Let all else go save here; come! stop the hole!
Hear how the water roar; there! at the end
The break is ten feet wide! now twenty! God!
The game is lost! Men, drop the sacks and fire!
Let those below us know we could not hold!
Look 'round you! like a sea the water spreads!
'Tis sweeping towards your house! Quick! take the wife
And children to the mounds; lead out your stock
And huddle it until the rescue comes!

How deep the plows are in the furrow now—
Both yours and mine—the water everywhere,
Grim, yellow, restless, while its lapping tongues
Whirl by the timbers of that thing called home
With vines still clinging to the lattice bars,
Or just the heartstring of a plain folk
Tossed out and broken, swept out in the wreck.

The boat is coming; save what it will take;
I know what you are leaving! Hush, be strong!
We cannot tie our memories up in quilts
For passing Charity to bring!

The wave has reached the churchyard fence by now,
Both yours and mine. Oh! may they dreamless sleep,
Baptized beneath our waters of despair!
So deep our hopes, and yet we were so sure;
But courage, men, and look before, before
Your faithful dog has seen you wipe your tears.

All day, all night, the ceaseless beat of hoofs,
Of mules, of cattle, through the city's mart,
As homeless now as we, led out to seek
The shelter that the willing stranger lends.
Where now we stand was once our market place,
We bought and sold our wares as other men;
But now, 'tis but the refuge place of those
Who, losing all they had, would still keep hope.

THE CREVASSE

WATERS RUSH THROUGH WITH A ROAR

WITH a mad rush like the Whirlpool of Niagara the waters from the swollen river burst through the gap and pour over thousands of acres of lands, destroy the crops, drown the cattle, carry away houses and fences and in a few days convert these fertile valleys into artificial lakes. The lakes fill gradually so that the loss of human life is not as great as it might be, but the cattle and stock seeking the higher ridges each day as the water rises are finally surrounded and must either swim for miles to reach the hills or else perish.

Crevasses like the above occurred at a number of points along the levee line during the flood of 1912 about the time it reached its highest tide. Two such breaks let the water into the St. Francis Basin at Graves Bayou, just below Memphis, and at Wilson just above; one break at Beulah let the flood into the great Yazoo Basin; one at Panther Forest let it into the Tensas Basin in the southern part of Arkansas; one at Salem, just below the Louisiana line, inundated all of northeast Louisiana; one just south of the mouth of Red River flooded the Atchafalaya Basin, and one at Hymelia, just above New Orleans on the west bank, filled the Lafourche Basin.

The water continues to flow through these openings for weeks and does not cease until the river has subsided within its natural bank, nor does the amount of water thus drawn off appear to cause any perceptible reduction of the flood plane in the river itself, although a check in the rise is apparent.

The duration of these floods in the lower Mississippi River delta is what makes them so much more disastrous than floods elsewhere. In 1912 the flood relief work conducted by the National Government began on April 4 and did not end until after June 18.

CAVING BANKS

CARRIED AWAY BY CAVING BANKS

CREVASSES or breaks in the levee system during high water are due to several causes: *First:* Faulty construction of some parts of the levee line built many years ago, when fraudulent contractors allowed stumps or the trunks of trees to remain in the embankment. These have since decayed and are discovered only by the water leaking through the levee during flood season.

Second: Weak or insufficient section to withstand the pressure of water that must be taken care of during the crest of the flood.

Third: Holes bored through or under the levee during low water by crayfish, muskrats or fiddlers, and "sand boils," or springs that find their way under the base of the levee through a sub-strata of white sand when the flood in the river reaches a height sufficient to force the water through.

Fourth: Caving, through which the foundation of the levee is undermined by the river and the levee itself is taken into the stream.

The above illustration shows the national cemetery just below New Orleans and gives some idea of how the levees are carried away in this manner. The line is usually located sufficiently far back from the bank of the river to obviate this difficulty, but frequently the channel encroaches upon the line much more rapidly than was estimated. Bank revetment in these caving bends is not only a sure means of preventive in such cases, but greatly aids navigation by holding the river to its channel. Crevasses do not occur often from this source, however, as the pressure of the water holds the bank, and excessive caving takes place just after the water has receded within its banks.

SAND BOILS

THE BEGINNING OF THE BREAK

"SAND BOILS" are frequently the cause of breaks in the levee, especially in the section of the delta above the mouth of Red River, and result from small streams of water being forced through a stratum of sand lying beneath the foundation of the levee. Small particles of sharp sand are carried through at first, and in the course of time the hole becomes larger and larger until the volume of water passing through gets beyond control and the levee is undermined and crumbles in.

Crevasses from this source are due to faulty construction; the beds of sharp sand not having been previously removed from the foundation when the levee was built. Much care has been given to the supervision and inspection of all levee work during the last twenty years and the foundation is now prepared so as to minimize the danger from this source by the removal of all improper material.

As the districts become more prosperous and as more money becomes available, the entire line is being re-inforced with a much wider base and a greater section, and when this work shall have been completed, crevasses from this source will be a thing of the past.

The picture above shows how the sand is cut away from beneath the levee by the small stream of water trickling through, and deposited about its orifice on the land side of the levee forming what appears to be the miniature crater of an extinct volcano.

When one of these leaks or "sand boils" is discovered by the guards a force is hurried to the scene and a "chimney" is built from sacks of mud so as to surround the hole allowing the water to rise sufficiently high to counteract the pressure from the river side. In this way the discharge is stopped and a break prevented.

SLOUGHING

THE SOFTENED SECTION SLIDES OUT

MANY miles of the existing levee line are not only below the required grade, but are weak in section owing to lack of funds with which to complete the work. The levee should have a slope on either side of three feet horizontally to every foot of height, but many miles of the levee have a slope of but two horizontal to one in height.

Such levees become thoroughly saturated after the flood has stood against them for months and not having a sufficiently flat slope part of the embankment slides or sloughs off, leaving the section too much weakened to stand the pressure.

Slides of this character are prevented by the construction of a wider base, built part of the way up on the land side with a crown forty feet in width. This reinforcement is known as the banquette and many miles of such embankment have already been built and have proven most effective, especially in the Upper Yazoo District in Mississippi. There are one hundred miles of levee thus reinforced, which have been built to grade and section, protecting this district and no break has occurred here since they were completed.

The picture above illustrates how these slides weaken the section and demonstrates graphically the incomplete condition of many miles of the present levee system. As the country back of the levee improves, greater revenues are derived and the levees are brought nearer to completion, but the process is slow. The people have taxed themselves to the last dollar they can stand, and the afflicted country is almost staggering under its burden. They feel that they have done their share and should not be called upon to bear the entire burden of walling off the water from half the nation.

EMERGENCY WORK

STRENGTHENED BY SACKS FOR MILES

NO CHAIN is stronger than its weakest link and there are many weak links in the chain of 1538 miles of levee along the Mississippi River. The report of the Mississippi Commission of 1912 shows that 586 miles of the line are still below the required grade. During the flood of 1912 hundreds of miles of this line were raised by piling sacks of earth on top of the levee as the water rose. Night and day for weeks during the period of flood tide men fought for their lives and their homes. For miles they lined these levees, filling sacks and piling up dirt to keep pace with the rising flood and it was only by such heroic work that greater damage was prevented. There were instances where the levee was raised in many places to as much as four feet by emergency work of this character after the flood had reached the top of the levees, and it was remarkable to note after the flood had subsided that miles and miles of these flimsy sack walls, built on top of the levee, had held back such a flood.

Emergency work of this character is very expensive as may be inferred from the millions of sacks used in making the fight. Earth of itself would be of no avail at such times, so it must be placed in sacks and these securely tied before being placed in position.

The picture shown above illustrates how hundreds of miles of levee were raised during the flood to prevent overtopping, and no soldiers fought harder over their breastworks, nor endured more exposure than did the people along these 1500 miles of levee in 1912. From Cairo to New Orleans they fought a common foe in the flood waters sent down upon them from the thirty-one states above.

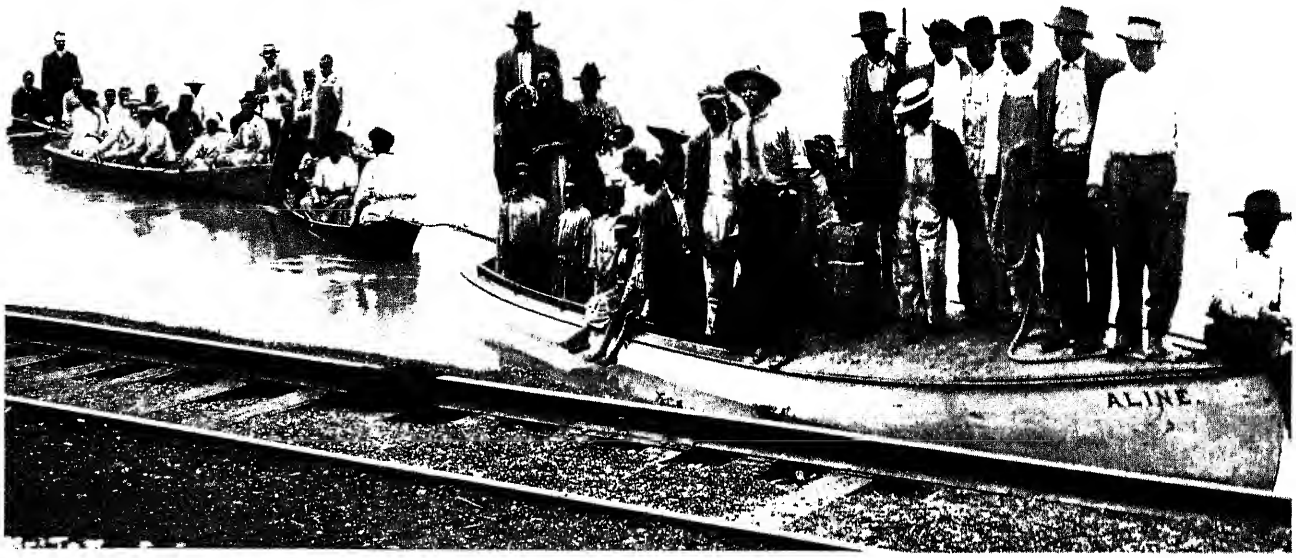
DESPERATE STRUGGLES

PROMPT ACTION PREVENTS MANY BREAKS

IT IS difficult for anyone who has never seen a high water fight along the lower Mississippi to realize what it means. When the stage of the river at Cairo has reached 51 feet on the gauge it is a signal for all of those who live along the 1,000 miles of the river below to prepare for a desperate fight against the floods. The approaching enemy, as the crest of the wave may be called, takes about six days to reach Memphis, about twenty-one days to reach the mouth of Red River, and about thirty days to reach New Orleans, so that some time is afforded for preparation.

Millions of sacks are ordered by the levee boards along the river and placed at convenient points so that they may be used in an emergency. Forces are organized, boats are chartered and guards are stationed so that the levee may be patrolled both night and day. As the flood reaches its highest stage in the river and begins to exert its pressure against the levee, the surface standing from ten to twelve feet higher than the land, weak places are discovered and men and material are rushed to the scene with the utmost dispatch, so that whatever leak may have developed may be checked in its incipiency.

Sometimes it is possible to prevent a crevasse by thus being on the alert and by working with the utmost dispatch. If a leak has been discovered through which the water is passing in increased quantities, showing that it is gradually cutting a larger hole, a crib is quickly built to exclude the water from the entrance. If it is a case of the water having softened the levee and the embankment sloughing off, additional earth is put on the river side to prevent the water from further seepage. The above picture illustrates one of these rallies to a weak point.



REFUGEES

DRIVEN FROM THEIR HOMES

AFTER the levee has broken and the water from the river begins to pour into the country back of it, steps are taken to spread the news as rapidly as possible to all parts that are likely to be inundated. In such sections as are now supplied with telephone lines the news is quickly conveyed, but in many instances it becomes necessary to put messengers on horseback and dispatch them quickly to isolated points, twenty or thirty miles in the interior, so that the inhabitants may not be taken wholly unaware.

The water spreads rapidly as it emerges from the opening in the levee, seeking the lower ground and the bayous and parallel streams which will eventually conduct it back into the Mississippi River some hundred miles below, and creeps up steadily day by day into the cabins of the poor and the dwellings of the rich alike.

A large part of the population scattered throughout these delat lands consists of negro tenants, who rent the land outright or share the crops with the owner. All that they possess is their household goods, their stock and their farm implements. They are prosperous and make a good living with the capital that they have thus accumulated. When crevasses occur these people lose everything. They attempt to remain in their cabins by building the floor higher as the flood rises day by day, but finally are driven to the house tops and must be taken out by boats sent by relief parties made up in the adjacent cities.

During the flood of 1912 thousands of these people were rescued after remaining many hours without food upon improvised rafts of logs or in the unsubmerged portion of their houses. The above illustration shows these poor people being brought out to the high ground by relief parties.

HOMELESS

THOUSANDS SUFFER BY NATION'S NEGLECT

ALL through the delta region are found the remains of prehistoric mounds, which are sometimes 30 feet high and more than 150 feet in diameter, and as the flood waters from the crevasses cover the adjacent country, the people, fleeing from their submerged cabins, seek these elevations to wait in safety above the line of the flood until boats can be sent to bring them out. Most of them escape with scarcely more than the clothes they have on and the household goods which they can take away with them, their family treasures being bundled up in bedquilts as they flee. Most of these homeless exiles are brought to Memphis, Vicksburg and Baton Rouge, located on the hills, and are cared for until the water subsides. They can then either go back to their ruined cabins and start over again with nothing but their hands and their will and such credit as may be extended to them by the merchants who will furnish provisions, or seek homes elsewhere in sections of the country not ravaged by the floods.

During the flood of 1912 the National Government fed 272,753 of these refugees and issued over seven and one-half millions rations. For more than sixty years the people of this country have been holding up their hands in supplication to the National Government, pleading and begging to be saved from this foreign invasion, and although during that time millions have been spent on the acquisition of foreign territory, still the people of this valley plead in vain.

The above illustration shows a large number of the negro tenants who have taken refuge on one of the prehistoric mounds and are waiting, surrounded by the icy waters of the Mississippi, exposed to the cold and the rain, until relief shall arrive.

RELIEF WORK

RATIONS AND SUPPLIES ARE CONTRIBUTED

FLOOD season in the lower Mississippi Valley under present conditions somewhat resembles preparation for war. First there is the organized effort to combat the floods and then the organized relief that must follow destruction and defeat. Secretary of War Henry L. Stimson, commenting upon these floods in December, 1912, before the Rivers and Harbors Congress, said:

"The devastation and the losses which were occasioned last year in that great Valley were brought home directly to the War Department, because the War Department was the great channel of relief through which the alms of the nation were extended to those who suffered in those great floods. The work of distribution of that relief was performed by Army officers. The million and a quarter of national funds which Congress distributed was distributed through those trusted agents of our Government, the Army officers, who are always appealed to whenever there is a duty requiring absolute fidelity and discretion.

"You may not know that for a long time we were feeding nearly two hundred thousand people along that great waterway with rations furnished by the United States, and we were offering shelter through tents furnished by the Army to over twenty thousand; and we were feeding on an average fifty thousand of their stock and cattle."

While the Government was extending this most beneficial aid, relief expeditions were fitted out by the citizens of every city from Cairo southward. The above picture shows a barge load of supplies from the merchants of Helena which is being sent down the river to aid the thousands who have been driven from their homes.

STOCK LOST

THE LOSS OF LIVE STOCK IS GREAT

THE floods that result from broken levees are not fraught with the same danger to human life that accompanies the breaking of the great reservoirs in a mountain gorge. In those cases the flood comes rapidly and whole villages are swept out in an hour and thousands of human lives may be lost. But in the cases along the Mississippi River when the levees break, the great basins are filled slowly and as the water creeps up gradually into the houses every chance is given to save human life.

It is not so with the dumb beasts, however, and thousands of head of hogs, horses, mules and cattle are drowned by the flood waters of the crevasses. Many head of stock that can be quickly herded and taken to the railroads are able to be shipped out and saved, but in many instances in a country that is forty miles wide and two hundred miles long, much of it thickly wooded, it is difficult to gather the stock together in time to save them. They recede to the higher ridges as the waters approach, until finally surrounded, and then they are either drowned in their attempt to swim the intervening gap of twenty or thirty miles, or are starved to death before being reached by relief boats. In 1912, 54,500 head of stock were saved by the Government relief parties.

One pitiful part about the overflow in the delta region is the enormous loss of wild game that follows. It is no unconmon sight to see numbers of rabbits huddled on a log almost exhausted and starving to death as they float about in the overflow, and I have frequently seen many herds of deer so tamed by starvation that they have come out to the settlements like domestic cattle.

The above illustration shows how the stock have gathered on one of these high points.

RAILROADS DAMAGED

MILES OF RAILROAD WASHED AWAY

IN 1880 there were but little more than 200 miles of railroad line in the entire 29,000 square miles constituting the alluvial delta. So marked has been the development of that country during the last thirty years because of the levee system, however, that 3800 miles of road now traverse it in every direction. When the levees break and the delta is overflowed, four great transcontinental railroad lines and two of the principal north and south lines of the country are forced to suspend operations. Freight and passenger traffic are interrupted, the mails are held up and millions of dollars are lost by damage to the roads.

The story of the losses by one of these roads as told by its President, Mr. B. F. Bush, will suffice for all:

"The Mississippi River overflow in 1912 incapacitated 617 miles of the St. Louis, Iron Mountain & Southern Railway, of which 352 miles was under water, some of it for a period of over five months. The value of the road under water was over $12,000,000 and the physical damage, as revealed by the repairs subsequently made, was $415,000. The loss in traffic has been conservatively estimated at $550,000, which would represent commerce to the value of $5,500,000, which was destroyed. In addition to this there was a considerable loss occasioned by a great deal of the farming land contiguous to the river not being fit for cultivation the ensuing season.

"For the year 1913, the physical damage to the Iron Mountain Railway was $460,000 and the loss in traffic is estimated at $196,000. This would make the loss for the two years $9,081,000. To this should be added the two years' loss of farm products by reason of the overflowed land being unfit for cultivation the seasons following the floods."

WIRE WRECKAGE

TELEGRAPH LINES ARE DESTROYED

NOT only are the transportation lines interrupted by these disastrous floods, thus stopping the mails and interfering with traffic, but communication by telegraph and telephone is sometimes entirely cut off. This inconvenience affects not only the people of the extensive delta over which the water is spread, but also seriously handicaps those who live on either side of this great inland sea of water. The telephone has come to be more than a convenience, it is a necessity; and all through the alluvial basin ramify the branches of the great telephone companies putting them in direct communication with the larger cities. When the levees break, enormous losses result from the destruction of these lines, communication is cut off from the outside world, and it may be days and even months before the water recedes and the lines can be restored.

The damage to the telegraph lines is very great when these floods occur because usually the main lines follow the principal trunk lines of railroad and when the latter are washed away the telegraph poles are thrown down and the wires are broken for many miles. During the overflow of 1912 many parts of the basin were so deeply submerged that the water reached the cross-bars on the poles, as may be seen from the illustration shown above.

No definite estimate can be given here of the exact amount of loss sustained by the various telegraph and telephone companies whose lines are affected, but it is sufficiently great to cause a positive set-back in the work of development which these companies have been carrying on in supplying that region with communication of this character. The interruption of the telegraph and telephone service of the country by floods of such extent and duration is an important factor to be considered by the National Government.

TOWNS INUNDATED

BUSINESS IS SUSPENDED FOR WEEKS

THE towns that have sprung up all through the delta region, built by the inhabitants upon their confidence in the ultimate success of the levees and with the hope that the hand of a just Government will sooner or later be extended to aid them, suffer greatly from these floods. Each one of them a flourishing and growing center of trade, with its substantial business buildings, its well-constructed dwellings, its churches and its schools, feels the decaying and corroding influence of the standing water. When the levees break, the water creeps stealthily into these towns, whether five miles from the river bank or forty miles in the interior, and rises higher day by day until each little town becomes a miniature Venice. Skiffs and small boats ply the streets in lieu of carriage and wagon, and sometimes for thirty or forty days this is the only means of conveyance.

While it is true that the water does not flood these towns to any great depth, rarely more than five or six feet, still it is sufficient to cause great damage to the property and serious loss to the business of the town.

The merchant suffers a two-fold loss, because not only are his own goods damaged, but the farmer upon whom he is dependent for trade being ruined, he loses whatever goods he may have advanced for making the crop. This loss is felt in turn by every wholesale merchant in the North and East that does business with these merchants, and they too, therefore, have become actively interested in bringing the matter to the attention of Congress.

The illustration shown above conveys some idea of the condition that exists in these little towns throughout the delta when the levee breaks. The town shown here was flooded by the Hymelia Crevasse and is forty miles west of the levee.

THE AFTERMATH

WRECKAGE AND RUIN RESULT

AS the river recedes within its banks and the flow through the break in the levee is discontinued, the back water begins to fall rapidly and the once inundated region presents a desolate and discouraging view. Bridges have been floated away, drifting logs and tree tops have lodged against the fences and broken them down, and flotsam and jetsam of every character is scattered everywhere. The ground is cracked and in many places covered with white sand, piled up like great snow drifts, rendering it unfit for cultivation.

The waters usually recede about the middle of May and the hot sun pouring down upon the thoroughly soaked earth, the odors arising from decayed material and the general unsanitary conditions that prevail in such cases make it difficult for those driven from their homes to return and take up their work. They do return, however, with renewed hope and the belief that the flood just passed will be the last one ever to be endured. The ditches are reopened, fences are put back, houses and barns are reconstructed, bridges repaired, and if able to obtain seed a crop is planted. After the flood of 1912 many of the people in the Yazoo Delta, as well as in the St. Francis Delta, were able to return and plant their crops in time to derive some revenue from the land, only to have their plantations entirely ruined by the succeeding flood of 1913.

The picture shown above illustrates how the ground cracks open after the water recedes, and frequently entire plantations that happen to lie immediately back of the break are so cut to pieces by the swift rushing water as to be unfit for further cultivation, deep gullies and holes being washed out for a mile back of the break.

AMPHIBIANS

STOPPING THE MAILS—INTERRUPTING COMMERCE

THE interruption of the mail service and the interference with interstate commerce resulting from the inundation of so large an area from overflows on the Lower Mississippi River render this problem peculiarly national.

During the flood of 1912 all railroad lines crossing the river at Cario, Memphis, Vicksburg, Baton Rouge and New Orleans were compelled to cease operations until the water subsided, for when the levees broke these east and west lines were interrupted by an expanse of water twenty to forty miles wide.

The principal north and south lines of railroad between St. Louis and New Orleans, such as the Yazoo & Mississippi Valley, the St. Louis Iron Mountain & Southern, the Texas & Pacific, and the St. Louis & San Francisco, were compelled to discontinue operations for many days at enormous loss to the roads and great inconvenience to the country.

DETAILED STATEMENT OF LOSS IN DESHA COUNTY, ARKANSAS

THERE are sixty-nine counties in the seven states affected by these floods, so that by using the loss sustained in this one county as a basis of estimate some idea may be obtained of the enormous loss that follows when the whole delta is inundated.

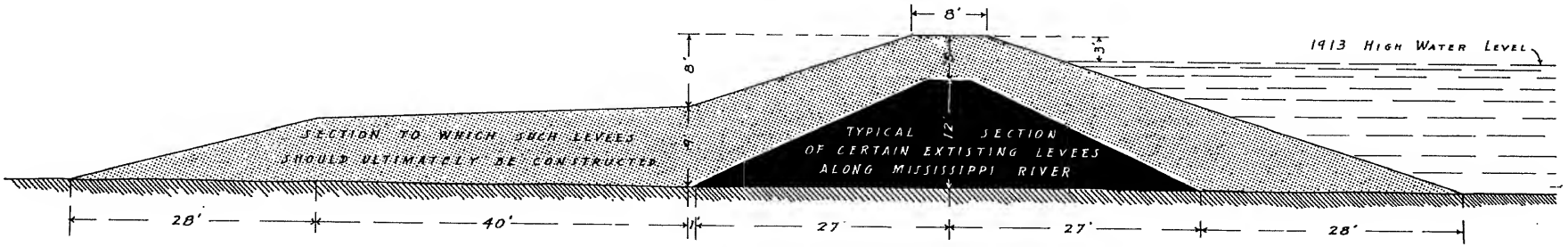
8000 bales of cotton destroyed, at $60 per bale	$480,000
4000 tons of seed, at $20 per ton	80,000
900 head of cattle lost, average price $8	7,200
160 head of horses and mules destroyed, at $100	1,600
1500 head hogs, at average price $5	7,500
Fences and houses washed away	25,500
Extra expense incurred in fighting the flood	98,000
Expense of closing the breaks in levees	180,000
Loss to business	18,000
Saw-mills, lumber on yards and timber	70,000
Cost to county for repairing bridges and roads	11,000
Plantations practically ruined, caused from break in levee	10,000
Total	$988,800

DAMAGE TO RAILROADS IN THE DELTA BY FLOODS OF 1912 AND 1913

Some idea may also be formed of the losses sustained by the several railroad lines which traverse the delta from the partial list shown in the table below:

Illinois Central R. R.	Property loss	$1,543,014	
	Traffic suspension	959,070	
			$2,502,084
Sunset Central Lines	Property loss (repairs)	$ 203,400	
	Account damage to sugar cane crop, direct	375,000	
			578,400
St. Louis & Southwestern Railway	Property destroyed	108,958	
	Property damaged	59,000	
	Traffic suspension	648,000	
	Aid to flood sufferers	4,000	
			819,958
Southiern Railway	Property loss	112,905	
	Traffic suspension	40,000	
			152,905
St. Louis, Iron Mountain & Southiern R. R.	Property loss	$ 642,230	
	Traffic suspension	445,980	
	Aid to flood sufferers	19,155	
			1,107,365
Mobile & Ohio Railroad	Property loss		50,670
St. Louis & San Francisco R. R.	Property loss	$ 226,475	
	Property loss (N. O. T. & M.)	31,000	
	Increase operating expenses	27,429	
	Aid to flood sufferers	5,174	
			290,078
Chicago, Rock Island & Pacific R. R.	Property loss	$ 96,480	
	Traffic suspension	185,000	
	Fight waters and detouring trains	157,300	
			438,780
Vicksburg, Shreveport & Pacific R. R.	Property loss	$ 44,561	
	Traffic suspension	122,917	
			167,478
Alabama & Vicksburg R. R.	Property loss	$ 20,997	
	Traffic suspension	103,362	
			124,359
Total			$6,252,037

CROSS SECTION SHOWING HEIGHT AND WIDTH TO WHICH ENTIRE LEVEE SYSTEM SHOULD BE BUILT AND SECTION OF CERTAIN EXISTING LEVEES IN THE SYSTEM WHERE BREAKS OCCUR



The above cross-section of the levee shows the height and width of the completed levees as compared with the levees which are still incomplete.

The heavy black portion of the diagram represents an end view of such levees as are still too low and weak to withstand the flood. Money has not been available to complete these portions of the system and they broke under the 1912 flood.

The lightly shaded portion of the diagram represents the section of earth that is still needed to make the existing levee high enough and strong enough to resist the greatest floods.

[56]

Many miles of the existing system are already built to this full grade and section, and such levees effectively withstood the floods of 1912 and 1913. Such a levee exists for 100 miles at the upper end of the Yazoo Basin in Mississippi, and there has been no break in that levee for over twenty years.

It will require 230,000,000 cubic yards of earth to bring the entire 1500 miles of levee up to this full grade and section, and it is estimated by the Mississippi River Commission that the cost will be about $60,000,000.

THE FOLLOWING TABLE SHOWS THE LINES OF EXISTING LEVEES ON BOTH SIDES OF THE RIVER FROM THE HEAD OF THE BASIN TO THE FORTS NEAR THE MOUTH

EAST BANK	Miles
From Hickman, Ky., extending southward	21
From Mississippi state line, near Memphis, to mouth of Yazoo River	306
From Baton Rouge, La., to Ft. St. Phillip	204
Total on East bank	531

WEST BANK	Miles
From Cape Girardeau, Mo., to New Madrid, Mo.	90
From Point Pleasant, Mo., to St. Francis River, Ark.	212
From Helena to White River	74
From Arkansas River to Red River	350
From Red River to Ft. Jackson	281
Total on West bank	1007

TOTAL LEVEE LINE 1538 MILES

THE LEVEE SYSTEM IS NOT A FAILURE

LEVEES, as a means of solving the flood problem on the lower Mississippi River have been a pronounced success, and the results thus far obtained demonstrate the feasibility and practicability of such a method beyond all doubt.

Col. Robert S. Taylor, member of the Mississippi River Commission, in a recent brief on the subject, writes as follows:

"That problem, as it was undertaken by the Mississippi River Commission twenty-eight years ago, has been worked out with substantial completeness. *The levee system has proved its practicability and effectiveness.*"

The Mississippi River Commission commenting on the flood of 1897, one of the greatest on record, during which thirty-eight crevasses occurred, expressed itself as follows:

"*The important fact that the flood waters can be permanently controlled by a system of levees that can be constructed within a limit of expense warranted by the advantages to be gained seems to have been fully demonstrated by the flood of 1897.*"

The levee system is far from complete, as will be seen from the following report of the Commission made after the flood of 1912:

"The development of the levee system has been carried on by both the Government and the several levee boards as rapidly as available funds would permit, but the top of the levee is still below the provisional grade for 586 miles of its length and the levee is deficient in the cross section contemplated for a large part of the entire line."

Commenting further upon the flood of 1912 the report says:

"*As the great flood of the present year passes away two conspicuous facts appear. The first is that the present levees withstood the flood with surprising success.*"

Again in 1913 this Commission of distinguished engineers says:

"Considering the great duration of high water this year and the fact that it exceeded in height all previous records for nearly 500 miles of river, the levees have made a very satisfactory showing *and inspire confidence that the levee system, when completed, will successfully withstand any flood that may come in the future.* * * * The sum of the above means that we must go on with levee construction in the way which has justified itself by so many years of successful control of Mississippi floods, but with increased energy, larger expenditures and better work. In that way only can we justify what we have already done and preserve and continue for the people of the whole country, the prosperity and happiness which have resulted from the beneficent work done in the past."

Charles Whiting Baker, editor-in-chief of Engineering News, in a recent article in the Scientific American states the case briefly as follows:

"That a few weak places in the levees failed in last year's flood and this year, is no fault of the levee system, but is due to the fact that the levees have been built, not to the height and the width and the strength that engineers knew to be advisable, but to such dimensions as the land owners along the river were willing to tax themselves for."

The following editorial from the New York Commercial is pertinent to the matter:

"In Europe levees have existed for centuries and have effectively restrained the flood waters of the Rhine, the Danube, the Po and other rivers which, though not as large as the Mississippi and its chief tributaries, present similar problems. The one objection to the levee system has been the fear that the river bottom will continue to rise, as sediment is deposited, and there is a limit to the height to which levees can be built. This feature has been studied in Europe for a century or more and the verdict of the engineers is that this seldom takes place and is very slight when it does. This seems to dispose of that argument against levees on the Mississippi."

CAVING BENDS MUST BE REVETTED

ONE of the greatest difficulties that enters into the problem of controlling the lower river is found in the caving banks. Permanent levees cannot be constructed along the banks of the river now, because of the possibility of their being undermined by the current.

I mention this fact because many not familiar with existing conditions often ask why we do not build the levees of concrete, or why we do not place in them a core of sheet piling to strengthen them and prevent seepage. Such permanent levees would undoubtedly be of the greatest advantage, but would be too costly to abandon to the encroaching river. Many miles of levee have had to be abandoned during the past twenty-five years because of these caving banks. Capt. C. H. West, now a member of the Mississippi River Commission, but for twelve years Chief Engineer of the Lower Yazoo Levee District, testifying before the Rivers and Harbors Committee in 1907 *stated that his levee line was 189 miles long and that since 1884, 172 miles of it had to be abandoned and new lines constructed because of caving banks.*

It is this factor in the problem of leveeing the river that makes the burden so onerous to the people of the region affected. If the money already expended by them could have been devoted to perfecting the lines originally built, there would be no need now for asking the aid of the Government in building the levees.

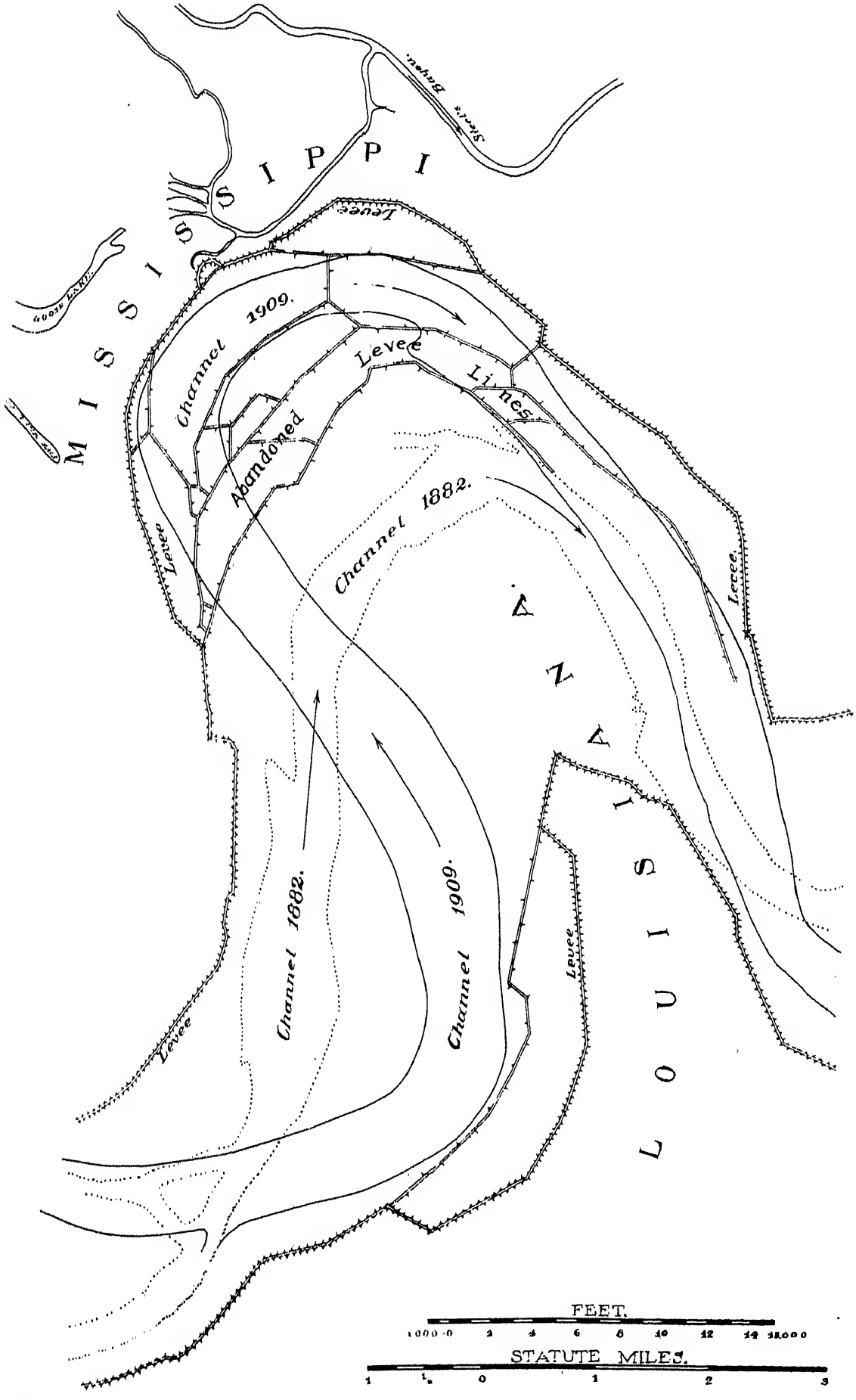
Bank revetment for the prevention of caving is therefore the most important work to be considered in dealing with the lower Mississippi River problem, both in the matter of flood prevention and channel improvement.

If the river could be held to its present channel by the judicious expenditure of money in a continuous manner, so that systematic work could be accomplished, a deep channel would soon be assured throughout the entire 1000 miles of the river below Cairo. To secure definite results it would not be necessary to revet the banks along this entire stretch, but only those banks in the sharp bends where exaggerated conditions exist.

Various estimates have been made as to the total number of miles of caving bank that will have to be revetted to secure definite results, and the ultimate cost. The Mississippi River Commission estimates that it will be necessary to revet about seven hundred miles of such banks and places the cost at about $80,000,000. If the work can be undertaken on so large a scale and pushed rapidly to completion, it is believed by all engineers who have made any study of the river that a permanent and definite channel of sufficient depth for all practical purposes will be secured and maintained.

Out of the meager appropriations allotted to it the Commission has been constructing these revetments for more than thirty years and caving in many of the worst places has been checked. The work progresses slowly, however, and can only be done from year to year in isolated places under the present system of meager appropriation.

One of the most important functions of reveting the banks is to prevent the river from cutting off some of the great bends, because it has been found that most disastrous effects result from these cut-offs where they are allowed to occur. There are instances on the river where such cut-offs would have occurred during the last thirty years if revetments had not been placed. Further instances where the imperative need of bank revetment has been shown, and where it has been used to great advantage, are found along the fronts of the cities bordering the river, such as at Greenville, Plaquemine and New Orleans, where parts of the cities themselves were threatened by the encroaching river.



HOW CAVING BENDS DESTROY THE LEVEES

WEAVING THE MAT

BANK PROTECTION IS IMPERATIVE

WHILE bank revetment has been carried on for many years in European countries, where stone and rip-rap were used in conjunction, the peculiar mattress work for bank protection used on the Mississippi River is the result of a long period of experimenting by the Mississippi River Commission. It is a combination of brush mattress and stone rip-rap. The mattress is made from willow brush woven into a fabric two or three hundred feet wide, a foot and a half thick, and a thousand feet or more in length, which is laid on the underwater surface of the bank, reaching from the low-water line to the toe of the slope. Above the low-water line the bank is graded to a flat pitch and covered with a thick rip-rap of loose, broken stone.

The making and placing of these huge brush mats is an art which has reached its highest development on the Mississippi River, and has attracted the attention and admiration of engineers all over the world. It has reached its present perfection as a result of over thirty years of costly effort and experiment.

Quite an extensive plant is maintained by the Commission for weaving and sinking these huge mats. Willow poles are cut from the bars along the river, loaded on barges and brought to the point where the mat is to be laid. The mat is woven on a barge constructed especially for the purpose, which is moored so that it extends from the shore outward the entire width of the mat. The barge drops down stream as the mat is woven and finally leaves it spread upon the surface of the water like a great carpet lying just over the underwater bank that is to be protected.

SINKING THE MAT

REVETMENT WORK IS ESSENTIAL

WHEN the mat has been completed great barge loads of rock which have been assembled at the point, are moored to its outer edge and the stone is evenly spread over the whole surface. The mat is securely held in place by wire cables attached to the bank, and sinks gradually into place as the stone is spread upon it. When it has sunk into place it fits the concave bank under water and gives it a rock facing that prevents further erosion.

Although some of these mats have been in place for thirty years the willow poles with which they were constructed are still as sound as when placed there.

The cost of building this character of revetment varies somewhat, but the average cost is about thirty dollars per linear foot, or about $150,000 to revet a caving bend a mile in length; but this cost could be reduced if the work were undertaken on an extensive scale.

Work of this character is permanent, however, and every mile of revetment that is laid brings the great undertaking nearer to final completion. Under the present plans of the Mississippi River Commission it is recommended that about $3,000,000 a year be devoted to this particular phase of the work of improving the Lower Mississippi. Such an amount will enable the Commission to utilize their plant most economically and will provide for the protection of such banks as are now caving so rapidly as to threaten the expensive levees that have been constructed back of them. While it is absolutely necessary to build the levee system to grade during the next five or six years, the revetment work can be carried on gradually and extended over a period of much greater length. It is, however, the most important work that can be done on the lower river not only as a means of insuring the levees to prevent floods, but also as the most direct means of securing a definite channel.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
WASHINGTON.

January 31, 1914.

Mr. A. S. Caldwell,
President, Mississippi River Levee Association,
Memphis, Tennessee.

Sir:

1. Replying to your request, received through Senator Ransdell, for my views as to the best method of treating the flood conditions of the lower Mississippi River, I take pleasure in saying that I concur fully in the views of the Mississippi River Commission in such matters.

2. There is only one way to protect the Mississippi Valley from floods, and that is by an adequate system of well-designed levees. There is only one way to permanently improve the navigability of this river, and that is by a durable and suitable protection of its banks. Fixed banks make it economical and safe to build the levees near to the river where the ground is usually high and firm and thus the volume of the levee is reduced and, at the same time, the maximum area of land is protected from overflow. Finally, if the levees are close to the river banks, and conform to them in direction, they will aid in deepening the channel, and, hence, in improving navigation.

3. Levees and bank protection, therefore, are the instrumentalities that must be relied upon for the reclamation and control of this waterway system.

Very truly yours,

Dan C. Gaillard

Chief of Engineers, U. S. Army.

SHALL THESE PEOPLE PLEAD IN VAIN

THROUGHOUT the foregoing pages we have endeavored to present in an attractive form, such brief facts regarding the floods on the Lower Mississippi River as will convince those who must consider the question that it is a matter of national importance. The Democratic party in its 1912 platform declared specifically and emphatically that the Mississippi River should be treated as a national project and that it was the duty of the General Government to build the levees and protect the land from floods.

President Woodrow Wilson in his letter of acceptance referred directly to this great national project as one of the important measures to be handled by his Administration.

The Corps of Engineers of the United States Army and the Mississippi River Commission have presented definite plans based upon a system of levees and bank revetments by which the floods can be most economically and most certainly prevented and have estimated the cost of constructing the levees at $60,000,000.

That the bed of the river is not rising as a result of building levees has been demonstrated by reference to the authorities who have studied the question for over three hundred years.

Outlets, Cut-offs, Reservoirs and Reforestation have been shown to be impracticable and of no avail as a means of flood prevention in the Lower Mississippi River.

Because of much recent comment and speculation by uninformed writers and newspaper contributors regarding the possibility and feasibility of other methods, we have quoted the expert testimony of the ablest engineers on the subject as far back as 1822 to prove conclusively that levees are the only means of definitely preventing floods on the Lower River.

The states that will receive the greatest benefit through the protection afforded have contributed two-thirds of the total amount of money already expended and pledge their further contribution and cooperation.

A measure drawn in accordance with the recommendations of the engineers, and with the advice and concurrence of representatives from every section of the several states affected, has been presented to Congress in a simple concrete form in order that the party pledge in reference to this particular flood problem may be enacted into law.

This measure, known as the Ransdell-Humphreys Bill, has received the sanction and approval of business men and trade bodies throughout the entire United States and is now before both branches of Congress.

For more than half a century the people of this particular part of the United States have pleaded for justice and year after year have presented their petitions to Congress for protection. We have shown by the illustrations presented that the country affected is to a large extent highly developed, a fertile valley of farms and cities seeking protection, not a wilderness asking reclamation at the hands of the Nation.

The story of the Valley and its people has been presented in sunshine and in shadow; in its progress and its promise and in disaster and distress. We have endeavored to let you see this country as it is from the wheat fields of Missouri to the orange groves of Louisiana, in order that you may judge for yourself of its wonderful possibilities. Contrasted with the bright future of the smiling valley we have presented the sadder picture of sorrow and suffering and have endeavored to convey some idea of the enormous loss that results from these floods.

No people have shown greater fortitude under similar circumstances, nor presevered against more overwhelming odds than have the people of this valley. Year after year their plantations have been ruined and their property has been destroyed by the floods of nearly half of the nation.

DESIGNED AND PRINTED BY
JAMES WILLIAM BRYAN PRESS
WASHINGTON, D. C.